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ABSTRACT

This annotated bibliography containing research on visual perception executed at photopic levels in artificial laboratory situations has been compiled to make information available that can be applied to scotopic perception of natural objects in natural situations. There are 407 reports or studies, published from 1945 through 1964, cited in this bibliography. In addition to military and government publications, the following journals were examined: "American Journal of Psychology," 1945-1964; "British Journal of Psychology," 1945-1964; "Journal of Experimental Psychology," 1945-1964; "Psychological Bulletin," 1945-1964; "Psychological Review," 1945-1964; and "Quarterly Journal of Experimental Psychology," 1948-1964. (RB)

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Visual Detection, Identification, and Localization: An Annotated Bibliography

by

Bernard Lyman

February 1968

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HumRRO Division No. 3 (Recruit Training)
Presidio of Monterey, California

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE

Technical Report 68-2
Exploratory Study 27

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The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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FOREWORD

This bibliography is the outgrowth of the Human Resources Research Office's Exploratory Study 27, Individual Night Training, which was concerned with the individual soldier's ability to use his unaided eyes and ears effectively during night operations. Although both perceptual and non-perceptual activities are involved in night operations, skill in the latter type of activity depends in large part on skill in the former. Therefore, a literature survey was undertaken to explore the information available on the nature of and conditions for effective visual perception at low light levels.

This bibliography was compiled at HumRRO Division No. 3 (Recruit Training), under Dr. Howard H. McFann as Director of Research, during the calendar year 1965.

HumRRO research for the Department of the Army is conducted under Contract DA 44-188-ARO-2 and Army Project 2J024701A712 01, Training, Motivation, Leadership Research.

Meredith P. Crawford
Director
Human Resources Research Office

SUMMARY

The overall goal of HumRRO Exploratory Study 27, Individual Night Training, was to determine the extent to which training can improve the ability of the individual soldier to use his unaided eyes and ears effectively during night operations. Because skill in perceptual activities plays a major role in night operations, a literature survey was undertaken to explore the information available on the nature of and conditions for effective visual perception at low light levels. This bibliography is the result of that survey.

Most research on visual perception has been conducted at photopic levels in artificial laboratory situations. A given report or study was included in the bibliography if it appeared that the information would be useful to the soldier in the field if the information applied at low light levels. With a few exceptions, the material falls within the areas of detection, identification, and localization.

Two indexes are included, an author index and a key-word-in-context (KWIC) index.

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Visual Detection, Identification, and Localization: An Annotated Bibliography

INTRODUCTION

PURPOSE AND CRITERION

Most research on visual perception has been executed at photopic levels in artificial laboratory situations, and the extent to which such information can be applied to scotopic perception of natural objects in natural situations is unknown. Consequently, a broad criterion was used for inclusion of studies and reports in this bibliography. It was simply the question, "Would this information be useful to the soldier in the field if it applied at low light levels?" Undoubtedly, many of the results and conclusions could not be applied to field situations involving detection, identification, and localization. From a practical standpoint, the bibliography includes a listing of many studies that ought to be modified where appropriate and repeated in natural settings at low light levels.

SCOPE

There are 407 reports or studies, published from 1945 through 1964, cited in this bibliography. In addition to military and government publications, the following journals were examined: *American Journal of Psychology* 1945-1964, *British Journal of Psychology* 1945-1964, *Journal of Experimental Psychology* 1945-1964, *Psychological Bulletin* 1945-1964, *Psychological Review* 1945-1964, and *Quarterly Journal of Experimental Psychology*, 1948-1964.

With a few exceptions, articles dealing with methodology, learning, reaction time, training, vigilance, and purely visual functions have been omitted. Relevant bibliographies are available for some of these topics. Within the areas of detection, identification, and localization, no assertion of exhaustiveness is made. In many cases, only one or two studies representative of a particular topic have been included.

Items are listed by author or authors, alphabetically. In each annotation a statement of the purpose and the results or conclusions of the study is given. When only part of the study or experiment was considered relevant to the bibliography, the irrelevant parts of the purpose as well as of the results and conclusions have been omitted. Since one of the primary purposes of the bibliography is to suggest leads for applied research rather than to supply specific information, the method and procedure are indicated only briefly. For the same reason, the results and conclusions usually are presented in a general way. Some of the statements of the results and conclusions were taken directly from the articles; others have been developed by the bibliographer, who assumes responsibility for any errors or erroneous implications in the annotations.

DESCRIPTION OF THE KWIC INDEX

A key-word-in-context (KWIC) index has been prepared as an aid to the user of this bibliography. It has been constructed by alphabetizing bibliographic titles according to key words—those words presenting the greatest amount of subject-oriented content. Each title is listed separately for each key word it contains; therefore, if a title contains four key words it will appear four times in the KWIC, alphabetically by key word. The key words are aligned down the middle of the page, with the remainder of the title "wrapped around" the key word. Virgules (//) mark the end of a title.

Example: (each key word is underlined)

Title: Acquisition of perceptual responses as a function of loading, location, and repetition.

KWIC index entries:

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To search the index, the user should frame a question and select key words from it. If first-selected key words do not yield the desired information, the user should search related topics or synonymous words. For example, if the user is interested in "Knowledge of Results," but the information under the key word "knowledge" is insufficient, he might look under "results," "reinforcement," or "feedback." Used in this manner, the KWIC should provide to the user all the information available in the bibliography pertaining to the topic.

When the searcher has found a title which interests him, the reference code provides location and other information. This reference code is aligned down the right column of the page and is in two parts. The first segment is the page number of the entry and can be used to locate the item in the bibliography; the next segment indicates the year in which the item was written. For example, the code 54/61 indicates that the title appears on page 54, and that the date of publication is 1961.

Because of space limitations of the computer printout, some long titles had to be truncated and do not appear in exactly the same form as in the report. However, every effort was made to retain the original context and key words. Titles that were shortened in this manner are indicated by an asterisk at the end of the title.

In compiling the KWIC index for this annotated bibliography, a few words such as "visual" and "stimulus," occurred so frequently in a general sense that they were not designated as key words unless they were used in a specific way that would aid users in narrowing the subject of visual search to particular aspects.

VISUAL DETECTION, IDENTIFICATION, AND LOCALIZATION

ADAMS, JACK A. *Experimental studies of human vigilance.* AF 19(604)-5705 Technical Documentary Report No. ESD-TDR-63-320 (final report), 1963.

Studies performance decrement in human vigilance tasks using complex visual displays. Alpha-numeric signals were used. Vigilance decrement usually occurred within a session of 2½ to 3 hours but did not increase with the number of daily sessions. Response-produced stimuli from decision behavior deterred the vigilance decrement.

ADAMS, JACK A. Test of the hypothesis of psychological refractory period. *J. exp. Psychol.*, 1962, 64, 280-287.

Studies the central decision time vs. expectancy explanations of the psychological refractory period. The decrement in the response to the second of two closely spaced stimuli in a bisensory discrete tracking task suggests that the decrement is due to the subject's expecting a longer delay and therefore not being optimally ready to respond.

ADAMS, JACK A. Vigilance in the detection of low-intensity visual stimuli. *J. exp. Psychol.*, 1956 52, 204-208.

Studies the detection of low-intensity visual stimuli in a vigilance task. A 110 minute watch period was used. The results showed: (1) The average number of stimuli detected was related to stimulus brightness and duration; (2) All groups showed a steady decline in proficiency over the 110 min. period; (3) All groups displayed a gain after a 10 minute rest; (4) Two groups having a short stimulus presentation time made a number of responses in the absence of the stimulus light.

ADAMS, JACK A. and BOULTER, LAWRENCE R. Spatial and temporal uncertainty as determinants of vigilance behavior. *J. exp. Psychol.*, 1964, 67, 127-131.

Studies the effects of temporal and spatial uncertainty on visual monitoring in a complex vigilance task. With three stimulus sources arrayed over a 144° field, mean response latency for speed of detection increased as temporal and spatial uncertainty increased.

ADAMS, JACK A. and CHAMBERS, RIDGELY W. Response to simultaneous stimulation of two sense modalities. *J. exp. Psychol.*, 1962, 63, 198-206.

Studies the effect of simultaneous presentation of auditory and visual stimuli in a tracking task on motor (right and left hand) performance. There was a superiority of bisensory over unisensory responding when stimulus events were certain. But when events were uncertain, impairment was inferred for bisensory responding because the faster audio response time was reduced in speed and synchronized with the slower visual response time.

ADAMS, O. S. Stereogram decentration and stereo-base as factors influencing the apparent size of stereoscopic pictures. Amer. J. *Psychol.*, 1955, 68, 54-68.

Reference is made to Wheatstone's report and later quantitative studies of the phenomenon that an object of fixed angular size looks smaller when the eyes are adjusted for near vision than when they are adjusted for far vision.

ADAMS, OSCAR S., CHAMBLISS, DAVIS J., and RIOPELLE, ARTHUR J. Stimulus area, stimulus dispersion, flash duration, and the scotopic threshold. *J. exp. Psychol.*, 1955, 49, 428-430.

Evidence is presented which supports the established finding that there is a decrease in the absolute scotopic threshold when there is an increase in stimulus area and exposure time.

AIBA, T. S. Can the absolute threshold be conditioned? *J. exp. Psychol.*, 1963, 65, 235-239.

Studies the effect of irrelevant stimuli on the absolute threshold to light. Subjects who had received repetitive pairing of a tone and bright light showed a higher absolute threshold to light when the tone was presented than did subjects who were not so conditioned.

ALLAN, MARY D., Training in perceptual skills. *J. of the British Association* at its Sheffield meeting in August, 1957.

Investigates the effectiveness of *whole* training in the development of recognition skills. Morse code and an aircraft recognition task were used. The author concluded that learning and recognition skill is an automatic process if attention is repeatedly directed to detail in relation to the whole perceptual pattern.

ALLUISI, EARL, A. Conditions affecting the amount of information in absolute judgments. *Psychol. Rev.*, 1957, 64, 97-103.

Reviews the data pertaining to experimental conditions which affect the span of absolute judgments. In addition to individual differences, the ability to make absolute discriminations among a set of stimuli seems to be a function of: (1) the range of stimulus variation (the greater the stimulus range, the greater the amount of information transmitted in bits per stimulus); (2) the spacing of stimuli (non-optimal spacings between stimulus categories reduce the amount of information transmitted); (3) the number of response categories (when the number of response categories is fewer than the number of stimulus categories the amount of information is lower than when the number of response categories is equal to or greater than the number of stimulus categories).

AMMONS, CAROL H., WORCHEL, PHILIP, AND DALLENBACK, KARL M. Facial vision: The perception of obstacles out of doors by blindfolded and blindfolded-deafened subjects. *Amer. J. Psychol.*, 1953, 66, 519-553.

Repeats an earlier laboratory study in an out-of-doors situation. The experimenters concluded there is no single condition necessary for object perception. Audition is the most reliable, accurate, and universal of the various clues used by the subjects. Subjects who were blindfolded only, rapidly learned to perceive outdoor objects under complex and variable conditions and generally did better than blindfolded and deafened subjects. Subjects with hearing showed sudden or insightful learning while those who were blindfolded and deafened learned more gradually.

AMONS, R. B. Experiential factors in visual form perception: I. Review and formulation of problems. *J. genet. Psychol.*, 1954, 84, 3-25.

Discusses some (15) of the more common meanings of the term perception, some (11) operational definitions, enumerates 33 empirical generalizations, and gives examples of predictions regarding the effect of learning variables on recognition responses.

ANDERSON, NANCY S., and FITTS, PAUL M. Amount of information gained during brief exposures of numerals and colors. *J. exp. Psychol.*, 1958, 56, 362-369.

Studies the relationship between amount of information displayed and the *span of apprehension*. A 0.1 sec. exposure and color or shape symbols and combined color-numeric symbols were used. The results showed that performance increased and then decreased as the information content per message increased. The author suggests that perceptual ability should not be described in terms of the number of objects reported. Reporting ability is tied to a specific level of complexity or information content of the material.

ANDERSON, NANCY, S. and LEONARD, J. ALFRED. The recognition, naming and reconstruction of visual figures as a function of contour redundancy. *J. exp. Psychol.*, 1958, 56, 262-270.

Extends and analyzes a previous finding that one form of redundant metric figures was more difficult to identify among a sample of similar figures than were random (nonredundant) metric figures. The results appear to support the hypothesis that subjects will find ways of utilizing only the amount of information called for by a perceptual task. In identification, classification, and learning tasks the subjects use only the distinctive details of a figure.

ANDREWS, R. S., JR. and RINGEL, S. *Certitude judgments and accuracy of information assimilation from visual displays.* Technical Research Note 145, USA Personnel Research Office, 1964.

Studies the relation between certitude and accuracy in an identification task. Slides containing 12 to 24 military flag symbols were presented. Later the same slides with two to eight symbols removed were re-presented. The results indicated: (1) viewers' feelings of confidence in the information assimilated are not good indices to the accuracy of their assimilation; (2) as the number of presented symbols increased. average accuracy and average certitude both decreased; (3) certitude may be affected by a display characteristic which has no effect on accuracy; (4) aspects of a display which affect certitude judgments are not necessarily the same for all viewers; (5) an eight-point scale, qualitatively labeled, provided a reliable and efficient measure of certitude.

ANSTEY, ROBERT L. and DIVISION STAFF. *Visibility measurement in forested areas,* U.S. Army Natick Laboratories, Earth Sciences Division, Special Report S-4, Natick, Massachusetts, 1964.

Visibility distances are given for the identification of partly occluded targets. The sightings were made outside during clear and sunny weather for chaparral and oak-grassland covers and the following kinds of forests: tropical deciduous, open and dense coniferous, mid-latitude mixed, and high latitude coniferous. Targets were humans, Zecchi discs, clipboards, and others. Some sightings were made with moving targets as well as with the observer in the prone and upright positions.

ANTROBUS, JOHN S. and SINGER, JEROME L. Visual signal detection as a function of sequential variability of simultaneous speech. *J. exp. Psychol.*, 1964, 68, 603-610.

Studies signal detection (brightness discrimination) during two concurrent cognitive tasks of varied talking and repetitive counting. Light was used as the signal. The results suggest that when environmental stimulation, in this study lively band music between trials, maintains arousal, subject-generated cognitive stimuli interfere with signal detection; when environmental stimulation is low, subject-generated stimuli support arousal but the positive effect of arousal on detections was obscured by the interference effect of the subject-generated cognitive stimuli.

ARCHER, E. JAMES. Concept identification as a function of obviousness of relevant and irrelevant information. *J. exp. Psychol.*, 1962, 63, 616-620.

Studies the effect of obviousness of stimulus differences upon concept identification when the manipulated information was either relevant or irrelevant. Two forms of squares and parallelograms were used. Performance was facilitated when the relevant information was obvious and was impeded when the relevant information was less obvious. A reverse finding obtained for irrelevant information. An additional finding was that men found the task easier when form was relevant rather than irrelevant. The reverse was true for women.

ARCHER, E. JAMES. Identification of visual patterns as a function of information load. *J. exp. Psychol.*, 1954, 48, 313-317.

Studies reaction time to identify oscilloscope pattern targets containing all possible combinations of one to four bits of relevant information and zero to two bits of irrelevant information. The two major findings were: (1) response time increases as a linear function of relevant information load; (2) response time was unaffected by the amount of irrelevant information. The data also indicated that practice increased response time and decreased errors, both of which effects, however, were independent of relevant and irrelevant information.

ARDIS, J. AMOR and FRASER, ELIZABETH. Personality and perception: The constancy effect and introversion. *Brit. J. Psychol.*, 1957, 48, 48-54.

Studies the relationship between shape constancy and introversion/extraversion as measured by the Minnesota TSE scale. A disc, square, and rod were used as stimuli. The results showed: (1) there was a tendency for men to show greater constancy effect than women; and (2) introverts showed lower constancy effect than extraverts.

ARNOULT, MALCOM D. Familiarity and recognition of nonsense shapes. *J. exp. Psychol.*, 1956, 51, 269-276.

Studies the relation between the recognition of nonsense shapes and the frequency of prior exposure and the delay between the familiarization session and a test session in which the subjects rated the shapes on a five-point scale of familiarity. The conclusions were: (1) there were no significant differences in familiarity as a function of delays of as much as five hours between the two sessions; (2) there were no differences in recognition as a function of the various amounts of delay; (3) familiarity of nonsense shapes was found to be a monotonic, negatively accelerated function of the frequency of experience.

ARNOULT, MALCOM D. Recognition of shapes following paired-associates pretraining. In G. Finch and F. Cameron (Eds.), *Symposium on Air Force human engineering, personnel, and training research*, Washington, Nat. Acad. Sci. Nat. Res. Council Publ. No. 455, 1956, 1-9.

Studies the relationship between verbal labeling and the recognition of nonsense forms. Subjects learned different verbal labels for various nonsense forms and were then given a recognition test. The results indicated that recognition increased as a function of the degree to which the responses in the labeling practice reflected associations made to the forms. The findings suggest that recognition, as a perceptual task is dependent in part, on the degree to which responses transfer from the first task to the task of recognition.

ARNOULT, MALCOM D. Shape discrimination as a function of the angular orientation of the stimuli. *J. exp. Psychol.*, 1954, 47, 323-328.

Studies the relation between angular separation and the discrimination of paired two-dimensional nonsense shapes. The results indicated: (1) on the trials on which the two shapes were actually identical errors increased as a function of increased angular separation (the range of errors was from 20% to 40%); (2) on the trials on which the two shapes were actually different, errors showed an initial decrease, followed by an increase, and a final drop as angular separation increased (the range of errors on these trials was from 12% to 15%); and (3) latencies on the "same" trials were consistently higher than on the "different" trials.

ARNOULT, MALCOM D. *Measures of shape discrimination performance in a study of the effects of angular orientation of the stimulus.* Human Resources Research Center, Lackland Air Force Base, 1951, Proj. 509-019-0001, Res. Note P and MS 51-10.

Studies the discrimination of paired two-dimensional nonsense shapes when the comparison shape is presented at various degrees of rotation. As measured by latency of response, discrimination became increasingly difficult as the comparison shape was rotated from 0° to 90°. The results suggest that accuracy and latency of discrimination are not equivalent measures and that judgments of "same" and "different" have different perceptual bases.

ATTNEAVE, FRED. Physical determinants of the judged complexity of shapes. *J. exp. Psychol.*, 1957, 53, 221-227.

Studies the relation between the physical characteristics of line drawings and the judged complexity of the shapes. About 90% of the variance of ratings was explained by: (1) the number of independent turns (angles or curves) in the contour; (2) symmetry; and (3) the arithmetic mean of algebraic differences, in degrees, between successive turns in the contour. Angular and curved shapes were judged about equally complex.

ATTNEAVE, FRED, *Perception of place in a circular field.* USAF Human Resources Research and Development Center, Lackland Air Force Base, 1954.

Studies the ability to localize a previously exposed light on an homogenous circular field. The subjects used both objective and subjective (mentally dividing the screen into four quadrants) landmarks within and without the screen. Variable errors taken along an axis pointed toward a given landmark, tended to decrease in the vicinity of the landmark. Constant errors were consistently directed away from nearby landmarks. Points were displaced toward the middle of the quadrant within which they were presented.

ATTNEAVE, FRED. Some informational aspects of visual perception. *Psychol. Rev.*, 1954, 61, 183-193.

Relates information theory to visual perception. Redundant visual stimulation results from either (1) an area of homogeneous color (including brightness), or (2) a contour of homogeneous direction or slope. Information is concentrated along contours and at those points on a contour at which its direction changes most rapidly such as at angles or peaks of curvature. Symmetry is another form of redundancy.

ATTNEAVE, FRED. *The relative importance of parts of a contour.* USAF Human Resources Research Center, 1951, Res. Bull. No. 51-8

Determines the subjectively salient parts of form contour. Line and dot patterns were used. The most salient parts of the form were the tops and bottoms of curvatures. The results suggested two hypotheses: (1) the most important segments of a contour are those most different from a straight line; (2) the points selected are those which, if joined by straight lines, would describe the polygon which best fits the figure presented.

AUDLEY, R. J. and WALLIS, C. P. Response instructions and the speed of relative judgments. *Brit. J. Psychol.*, 1964, 55, 59-73.

Studies the effect of the stimulus continuum position on speeds of relative judgment. Light patches of different luminance were used. The results suggest that the speed with which a relative judgment is made between two stimuli on any given dimension depends upon the relation between the general position of the stimuli on the dimension and the direction of the required judgment along this dimension. Subjects were quicker at choosing the brighter than the darker of two relatively intense stimuli but quicker at choosing the darker of two relatively dark stimuli.

BAIRD, J. C. Size of retinal image as a perceptual cue. *Perceptual and Motor Skills*, 1964, 18, 529-532.

Studies size perception under conditions of reduced distance cues using a luminance rectangle as a target stimulus. In comparing the size of a comparison stimulus presented with distance cues with the size of a standard stimulus presented without distance cues, observers were able to judge correctly the relative image sizes of the two objects in accordance with their retinal image sizes. With minimal distance cues, size judgments of an object depend only upon its subtended retinal image size.

BAIRD, J. C. Retinal and assumed size cues as determinants of size and distance perception. *J. exp. Psychol.*, 1963, 66, 155-162.

Studies the effect of instructions on the role of the retinal image in the perception of size and distance. One set of instructions (objective) emphasized judging physical size while the other set (analytic) required size judgments in terms of the retinal image. When other visual cues were eliminated, the assumed size of an object was an important determiner of its estimated size and distance under objective instructions but notunder analytic instructions. When objective instructions were given, size and distance estimates were positively correlated. When analytic instructions were given,no significant relationship was found between judgments of size and distance.

BEACH, LEE ROY. Cue probabilism and inference behavior. *Psychol. Monogr: General and Applied.* 1964, 78, 1-20.

Studies the use of probabilistic cues in making inferences regarding an object's class membership. The results indicated that for unfamiliar objects cue probabilism, based on frequency of past occurrence, is an important determiner of the subject's inferences. With increased familiarity, the use of recognition and of similarity becomes important. For unfamiliar objects which are similar to familiar ones, the inference is the class appropriate to the familiar object.

BECK, JACOB. The effect of gloss on perceived lightness. *Amer. J. Psychol.,* 1964, LXXVII, 54-63.

Studies the effect of surface gloss on perceived lightness. When the average contrast-ratio for square target and surround is the same for a matte and a glossy surface illuminated directionally, the glossy surface is seen as darker and maintains greater constancy with increasing illumination than the matte surface.

BEEBE-CENTER, J. G., MEED, L. C., WAGONER K. S. and HOFFMAN, A. C. Visual acuity and distance of observation. *J. exp. Psychol.,* 1945, 35, 473-484.

Studies the relation between visual acuity and observation distance. Observation distances varied from about 30 feet to about two miles. For practical purposes visual acuity, defined in angular terms, remained constant over the range of distances. The discrepancies from constancy were slight, relative to the distances involved, and seemed explicable in terms of changes in contrast and illumination.

BELBIN, EUNICE. The influence of interpolated recall upon recognition. *Quart. J. exp. Psychol.,* 1950, II, 163-169.

Studies the effect of interpolated immediate recall on the recognition of a picture. Only 25% of the subjects asked to recall the picture prior to a recognition test correctly identified it on the test; whereas, 88% of those given only the recognition test correctly identified it.

BELLAIRE, FRANK R. and ELDER, FLOYD C. *Scintillation and visual resolution over the ground.* Report of Project MICHIGAN, Willow Run Lab. Univ. of Michigan, U.S. Army Signal Corps, Contract DA-36-039 SC-78801, 1960.

Studies the meteorological conditions contributing to scintillation. Scintillation, or the fluctuation in the intensity of the light from a constant target source, affects visual resolution and therefore reduces the usefulness of optical devices. Scintillation appears to be primarily a function of the vertical temperature gradient and the vertical motions within the ground layers of the atmosphere. These factors are interrelated and are complicated functions of other meteorological parameters, the experimental arrangement, and the character and the roughness of the ground surface.

BEVAN, WILLIAM and TURNER, EDWARD D. Assimilation and contrast in the estimation of number. *J. exp. Psychol.*, 1964, 67, 458-462.

Studies the effect of frame size and instructions on the estimation of the number of dots in a scatter. When the instructions to attend to the frame and dots as figure were used with a large frame, there was a tendency to overestimate numbers; with a small frame there was a tendency to underestimate. With instructions to attend the frame as ground, the relationships were reversed.

BEVAN, WILLIAM Jr., and ZENER, KARL. Some influences of past experience upon the perceptual thresholds of visual form. *Amer. J. Psychol.*, 1952, LXV, 434-442.

Determines the effect of previous exposure on the intensity thresholds of simple relatively non-meaningful designs and the effect of such practice on the thresholds of new but equivalent designs. Limens of first perception (detection), incomplete perception, and complete perception (identification) were used. The results showed: (1) Limens of first perception and of incomplete perception in the initial session were lowest for closed outline figures and highest for figures with narrow segments. No differences were found for open linear figures, nor for disconnected linear segments. The limen of complete perception was reliably higher for figures with narrow segments than for others. (2) The limens for new designs presented for the first time after practice were reliably lower than those for figures presented initially. (3) There was a lowering of limens for designs presented in the initial and the later exposure sessions.

BHATIA, B., and VERGHESE, C.A. Constancy of the visibility of a moving object viewed from different distances with the eyes fixed. *J.O.S.A.* 1963, 53, 283-286.

Discusses the relationship between viewing distance and the linear size threshold of a moving object. If the speed of an object, the duration of its exposure, and the size of the opening in which the object appears remain constant, the linear size detection threshold does not vary with changes in the distance between the object and the observer from one to five meters. However, the angular size threshold varies markedly over these distances, if the angular size of the opening, the angular velocity, and the duration of exposure remain constant.

BIERSDORF, W. R., OHWAKI, SONOKO, and KOZIL, D. J. The effect of instructions and oculomotor adjustments on apparent size. *Amer. J. Psychol.*, 1963, LXXVI, 1-17.

Studies the effect of instructions and viewing conditions (binocular, monocular, and monocular plus artificial pupil) on apparent size. The subject's task was to adjust the size of a diamond shaped form comparison target to that of a near standard. With instructions to make the comparison target the same "real" or physical size as the standard, almost full constancy was obtained regardless of the viewing conditions. With instructions to disregard the "real" size of the targets as well as the distances, there were smaller changes in apparent size and these were more related to viewing conditions.

BILDERBACK, LINDA G., TAYLOR, ROBERT E., and THOR, DONALD H. Distance perception in darkness. *Science,* 1964, 145, 294-295.

Studies the perceived size and distance of round stimuli in horizontal and vertical planes with presumed cues to size which were present and systematically eliminated. There was a consistent tendency for the horizon object to be judged the closer and larger, but the introduction of cues reduced the effect.

BINDER, ARNOLD. A statistical model for the process of visual recognition. *Psychol. rev.,* 1955, 62, 119-129.

Presents a statistical model of visual recognition based on the following common characteristics of recognition experiments: (1) a stimulating situation; (2) a set of instructions; (3) a general class of potential stimuli out of which a particular one is chosen; (4) a response by the subject; and (5) a general class of acceptable responses out of which one is made.

BITTERMAN, M. E., and KRAUSKOPF, JOHN. *Some determinants of the threshold for visual form.* WADC Technical Report 53-331, Wright Air Development Center, Air Research and Development Command, USAF, Wright-Patterson Air Force Base, Ohio, 1953.

Studies the foveal form thresholds for luminous figures briefly exposed in a dark room. The figures were: circle, square, diamond, triangle, cross, star, pentagon, rectangle, L, X, T, and H. At prethreshold levels, there were systematic distortions of form such as the tendency for corners to round and gaps to close. Form thresholds varied inversely with exposure time, area, and magnitude of critical detail.

BITTERMAN, M. E., KRAUSKOPF, JOHN, and HOCHBERG, J. E. Thresholds for visual form: A diffusion model. *Amer. J. Psychol.,* 1954, LXVII, 205-219.

Studies the foveal form thresholds for briefly exposed luminous figures. Geometric forms were used. The form threshold, measured in terms of the illumination intensity necessary for identification, varied directly with the ratio of perimeter to area and inversely with the magnitude of critical detail.

BLACKWELL, H. R., and SMITH, S. W. *Report of Project MICHIGAN, the effects of target size and shape on visual detection: II. Continuous foveal targets at zero background luminance.* Rep. No. 2144-334-T, 1959, AD 211452.

Measures the luminance difference for threshold detectability of circles, rectangles, multiple-legged targets, and targets of two rectangular areas of different dimensions. With a forced choice procedure, the results showed that circular targets were more readily detected than noncircular targets of equal area.

BOLLES, ROBERT C., and BAILEY, DANIEL E. Importance of object recognition in size constancy. *J. exp. Psychol.*, 1956, 51, 222-225.

Studies the role of familiarity in size constancy. Size judgments of familiar objects based on verbal descriptions of the objects were compared with visual judgments made under free viewing conditions. Visual size constancy was concluded to depend more on identification of the object than on perceived size. Nearly perfect size constancy was found in both judging conditions.

BORRESEN, C. ROBERT, and LICHTE, WILLIAM H. Shape-constancy: dependence upon stimulus familiarity. *J. exp. Psychol.*, 1962, 63, 91-97.

Studies the effect of shape familiarity (number of previous exposures) and orientation of the standard stimulus during the familiarity period on shape constancy. Attneave-like shapes were used. Shape constancy was found to be a positive function of shape familiarity. The number of orientation positions was relatively unimportant.

BOYNTON, ROBERT M. Recognition of critical targets among irrelevant forms. In Joseph W. Wulfeck, and John H. Taylor (Eds.), *Form discrimination as related to military problems*. Armed Forces, NRC Committee on Vision, Nat. Acad. Sci., Nat. Res. Council Publ. 561, 1957, 175-184.

Studies the influence of the number of figures in the display, the distance between the observer and the display, exposure time, and contrast on the recognition of angular edged targets among irrelevant curvilinear forms. In general, the results showed that: (1) the greater the number of figures, the fewer correctly identified; (2) the greater the distance, the fewer correctly identified; (3) with an increased exposure time there is a slight increase in the percentage of correct responses; and (4) the greater the contrast, the greater the percentage of correct responses. A second part of the study investigated the effect of increasing the subjects' tendencies to guess on the detection and recognition of targets. The results clearly suggested: (1) no increase in correct recognition; (2) a slight increase in detection-without-recognition; and (3) a larger increase in reports of targets which are not really there.

BOYNTON, ROBERT M., ELWORTH, CHARLES, and PALMER, RICHARD M. *Laboratory studies pertaining to visual air reconnaissance.* WADC Technical Rep. 55-304, Part III, AD 142274, Univ. of Rochester, Aerospace Med. Lab., Wright Air Development Center, Air Research and Development Command, U.S. Air Force, Wright-Patterson Air Force Base, Ohio, 1958.

Studies some of the relevant variables involved in visual air reconnaissance. Geometrical forms and struniforms were used. The probability of finding a critical target depended on: (1) the complexity of the background against which the target was viewed; (2) the distance between the observer and the ground, or altitude itself; (3) the contrast between the target on the ground and the ground itself; (4) the viewing time; and (5) the size of the target which is being sought. The recognizability of familiar targets depends upon the position of the target in the visual field. Targets are most recognizable on the horizontal plane, slightly more on the left than on the right, and least recognizable when located above the fixation point of the eye. The results were qualitatively about the same for each eye alone and for the two together, though binocular performance in general exceeds monocular performance.

BRICKER, PETER D., and CHAPANIS, A. Do incorrectly perceived tachistoscopic stimuli convey some information? *Psychol. Rev.*, 1953, 60, 181-188.

Studies the effect of previously exposed but incorrectly identified nonsense syllables on later correct identification. The results showed that significantly fewer additional guesses were needed to identify incorrectly perceived stimuli than to make the correct response in a series of random guesses.

BRODY, HILDA R., CORBIN, H. H., and VOLKMANN, JOHN. Stimulus relationships and methods of visual search. *Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Studies the relation between field size and matrix size and search time. Using a relatively homogenous 160° field, it was found that search time varies directly with angular search area and varies inversely with stimulus brightness. Target stimuli were ¼ inch spots of orange light produced by small neon lamps. When the eye was fixated, at high brightness levels the stimuli could be seen over the entire range. At medium brightness, the range was about 70° and at low brightness it was about 15°. For brief stimuli, detection seems to be better for the fixated eye. With a triangle in a rectangular matrix of circles it seemed that for small matrices there was no search, for medium ones the search seemed to begin at the center and then wander out, and for large matrices there appeared to be some system of "reading" the matrix.

BROUSSARD, I.G., WALKER, R.Y., AND ROBERTS, E.E., Jr. *The influence of noise on the visual contrast threshold.* U.S. Army Med. Res. Lab., Rep. No. 101. AD 2790, 1952.

Studies the effect of auditory noise on contrast thresholds for patches of light on less bright backgrounds. For low brightness differences, a background noise of 90 decibels over a two hour period did not affect the threshold. However, for differences near the discrimination threshold there was a significant increase in response time.

BROWN, JOHN. Distortions in immediate memory. *Quart. J. exp. Psychol.* 1956, VIII, 134-139.

Studies distortion in immediate memory. Sequential judgments were made of pairs of identical abstract geometrical figures presented 10 seconds apart. Subjects who had been led by instructions, prior to, or at the time of the second exposure, to expect a change in the second member of each pair, reported changes. The results suggest that the distortions were due to memory rather than to different perceptions.

BROWN, JOHN. Some tests of the decay theory of immediate memory. *Quart. J. exp. Psychol.*, 1958, X, 12-21.

Studies the effect of presenting additional stimuli to which the subject makes responses on the memory for stimuli which the subject is instructed to remember. Required stimuli consisted of between one and four pairs of consonants (excluding *Y*). Additional stimuli consisted of five pairs of number digits copied directly from tables of random numbers. Even when the number of to-be-remembered stimuli is well below the memory span, forgetting occurs if the presentation of additional stimuli delays recall for several seconds. The effect of the additional stimuli depends only slightly on their similarity to the to-be-remembered stimuli and their effect is negligible when they precede, instead of follow, the stimuli. The effect of additional stimuli interpolated before recall remains considerable even when there is an interval of several seconds between presentation of the to-be-remembered and additional stimuli.

BROWN, JOHN LOTT. Relations among dark adaptation, the spectral character of illumination and the visual task. In Robert Heath Brown (Ed.), *Illumination and visibility of radar and sonar displays.* Armed Forces NRC Committee on Vision, Nat. Acad. Sci., Nat. Res. Council Publ. 595, 1958, 55-64.

Discusses the relation between visual acuity and illumination level and characteristics of the visual task. Visual acuity at a given level of illumination increases rapidly during dark adaptation and reaches a maximum determined by the level of illumination. If the level of illumination is very low, maximum acuity is delayed by the late recovery of rod sensitivity. The relation between the increase in sensitivity, the time spent in darkness after light adaptation, and the ability to perform a visual task, depends on the nature of the visual task.

BROWN, JUDSON S., KNAUFT, E.B., and ROSENBAUM, G. The accuracy of positioning reactions as a function of their direction and extent. *Amer. J. Psychol.*, 1948, 61, 167-182.

Studies the accuracy with which subjects in total darkness are able to position the right hand and arm 0.6, 2.5, 10.0 or 40.0 cm. distant. The results indicated: (1) there is a tendency to overshoot the intended mark at the shorter distances, and to fall short of the intended mark at the longer distances; (2) the percentage error (magnitude of error relative to stimulus distance) is maximal at short distances and tends to decrease with each increment in distance; (3) movements away from the body exhibit smaller percentage errors in positioning than do movements toward the body at comparable distances from their respective starting points; (4) the variability of positioning reactions increased significantly with distance under all the experimental conditions; (5) the variability of positioning movements directed away from the body is greater than that of movements toward the body at distances of 10 and 40 cm. The relationship is reversed, however, for distances of 0.6 and 2.5 cm.

BROWN, R.H. *The visual discrimination of velocity as a function of stimulus duration and luminance.* USN, NRL, Report No. 4372, 1954, AD 32632.

Studies the effect of luminance and exposure time on the discrimination of velocity. For exposure times under 0.1 seconds the discrimination is determined by the product of stimulus luminance and duration. For longer intervals, the discrimination appears to depend on luminance alone. Since duration and speed interact the results suggest that distance, which is the product of duration and speed, is a relevant variable in the discrimination of velocity.

BROWN, R.H., and CARL, J.M. *Visibility in an empty visual field.* USN, NRL, Report No. 5072, 1958, AD 153207.

Determines the threshold diameter of a black dot on an homogenous white field. The threshold diameter of a dot located near the periphery of the field was over five times as great as that of a dot located near the center of the field. There were also large individual differences in the threshold diameter.

BRUNER, JEROME S. Neural mechanisms in perception. *Psychol. Rev.*, 1957, 64, 340-358.

In a summary of the characteristics of perceptual representation, the following points were made: (1) perceptual identification can be likened to the determination of the fit between a model and some sample that is being matched to it; (2) the act of perceiving almost always is accompanied by a loss of information which is due to the limited attention span of the human organism; (3) cognitive models or representations appear to generate processes of their own. The first of these is a normalizing tendency exerted on the percepts they generate when stimulus input occurs. Perceptual invariance with variable stimulation is an example.

BRUNER, JEROME S. On perceptual readiness. *Psychol. Rev.*, 1957, 64, 123-152.

Discusses perceptual readiness as it relates to the author's view that perception depends on a set of organized categories in terms of which stimulus input may be sorted and given identity. The more accessible a category, the less is the stimulus input required for it to be sorted in terms of the category. Category accessibility is determined by the likelihood of occurrence of events learned by the person in his daily life. Failure of perceptual readiness comes about through a failure to learn appropriate categories for sorting the environment and through a process of interference whereby more accessible categories with wide acceptance limits serve to mask or prevent the use of less accessible categories for the coding of stimulus inputs.

BRUNER, JEROME S., BUSIEK, ROBERT D., and MINTURN, AL LEIGH. Assimilation in the immediate reproduction of visually perceived figures. *J. exp. psychol.*, 1952, 44, 151-155.

Discusses the tendency for stimuli to appear like the "normal" or "modal" objects of their class. Stimuli were four of the original Carmichael, Hogan and Walter figures: trowel-pinetree, stirrup-bottle, lima bean-canoe, and hat-beehive. When an ambiguous figure to be shown to the observer is labeled prior to its exposure, it tends to be reproduced more like its given label than when it is not so labeled. The same figure, labeled differently for two groups, will tend to be reproduced differently by the two groups.

BRYDEN, M.P., and RAINEY, CHRISTOPHER A. Left-right differences in tachistoscopic recognition. *J. exp. Psychol.*, 1963, 66, 568-571.

Studies the effect of location on tachistoscopic recognition. Letters, geometric forms, and outline drawings were used. Stimuli presented simultaneously in the left and right visual fields were more readily recognized in the left field. With successive presentation, there was right field superiority. The results suggest that the left-right differences increase with increasing stimulus familiarity.

BURNHAM, ROBERT. Comparative effects of area and luminance on color. *Amer. J. Psychol.*, 1952, LXV, 27-38.

Studies the effect of luminance and patch size on the perception of color. The test patches subtended 2 and 12 degrees. Luminances were 0.84 and 6.30 foot Lamberts. The colors appeared brighter at the higher luminance level and they appeared more saturated in the larger area regardless of the luminance level.

BURSILL, A.E. The restriction of peripheral vision during exposure to hot and humid conditions. *Quart. J. exp. Psychol.*, 1958, X, 113-129.

Studies the effect of exposure to high temperatures on the detection of peripheral visual signals while engaged in a central pursuitmeter task which required attention. The temperatures were 70/60°F and 105/95°F. The peripheral signals were presented 20, 50, and 80 degrees left and right of the fixation point. The results showed a tendency for the field of awareness to be funneled towards the center. Signals presented at greater eccentric angles had a higher probability of being missed in the hotter condition. The longer the previous exposure to heat, the greater was the tendency to miss signals, but the effect did not always appear to be progressive during the actual performance.

BUTLER, J. Visual discrimination of shape by humans. *Quart. J. exp. Psychol.*, 1964, XIV 272-276.

Studies the relation between shape and reaction time in a visual discrimination test. The results indicated the following order of increasing difficulty in discrimination: (1) circle vs. triangle; (2) circle vs. square; (3) square vs. triangle; and (4) triangle vs. diamond. The results also indicated that up-down mirror image shapes are more easily discriminated than left-right mirror image shapes.

CALVIN, ALLEN D., and TYRRELL, SYBIL, Hollins College: SCHULZ, R.E., and KOONS, ROBERTA G., Michigan State Univ. The effect of exposure-time on the relation between perceptual organization and intelligence. *Amer. J. Psychol.*, 1958, LXXI, 573-577.

The study corroborated an earlier study by Krech and Calvin in which a biserial *r* of 0.91 was found between scores on the Wechsler vocabulary test and the reproduction of dot patterns tachistoscopically exposed for 0.06 seconds. The present authors found that longer exposure times facilitated pattern reproduction by subjects with lower intelligence.

CARLSON, V.R. Adaptation in the perception of visual velocity. *J. exp. Psychol.*, 1962, 64, 192-197.

Studies the effect of adaptation to an orbitally rotating pattern on the perception of a moving test stimulus. Two degree line sectors of light were used. When adaptation and test motions were in the same direction, the results were generally consistent with the waterfall illusion after-effects. There was little or no after-effect when the two motions were in opposite directions.

CARLSON, V.R. Size-constancy judgments and perceptual compromise. *J. exp. Psychol.*, 1962, 63, 68-73.

Studies the effect of instructions on size judgments and size constancy. Triangles were used as targets. A "perspective-size" instruction produced a greater degree of overestimation than an "objective-size" (i.e. actual physical size) instruction. The difference from a physically correct size-match was as great as that obtained in the opposite direction when subjects judged in terms of projective-size. The results suggest that size-constancy represents the basic functional relationship between object-size and perceived-size, rather than that perceived-size is a compromise between object-size and angular retinal-image size.

CARLSON, V.R. Effects of sleep-deprivation and chlorpromazine on size-constancy judgments. *Amer. J. Psychol.*, 1961, LXXIV, 552-560.

Studies the effect of sleep-deprivation on size-constancy judgments. Subjects made size matches with triangles as targets after 47 and 71 hours of sleep deprivation, and following administration of placebos and 200 mg. of chlorpromazine which was used as a low motivation comparison condition. There was some over-estimation of size with placebos, but sleep deprivation produced significantly greater over-estimation.

CARLSON, V.R. Overestimation in size-constancy judgments. *Amer. J. Psychol.*, 1960, LXXIII, 199-213.

Studies the effect of judgment instructions on perceived size. The stimulus objects were isosceles triangles. When the observer is asked to judge actual physical size, perceived size tends to increase with distance. When the observer is asked to judge visual projective size, perceived size decreases with increasing distance. When the observer is asked to base his judgment upon a naive, natural impression of size, size-constancy is nearly perfect, with some tendency toward underconstancy.

CARLSON, WILLIAM S., and TINKER, MILES A. Visual reaction-time as a function of variations in the stimulus-figure. *Amer. J. Psychol.*, 1946, 59, 450-457.

Studies the effects of ring size, break size, and brightness of a Landolt ring-like target on reaction time. The results indicated that latency increases as the figure is presented in the visual periphery, that latency varies inversely with the size of the break to be discriminated, and that changing illumination within a small range produced a statistically non-significant curvilinear effect on latency of response. Latency was significantly greater when the critical portion of the stimulus-figure appeared in the lower half of the visual field than when the upper half was involved.

CASPERSON, ROLAND CARL. The visual discrimination of geometric forms. *J. exp. Psychol.*, 1950, 40, 668-681.

Discrimination data were obtained for 30 solid geometric figures consisting of five variations of six basic forms: an ellipse, triangle, diamond, rectangle, cross and star. The frequency of report as well as the stimulus variables related to discrimination were considered. The ellipses exceeded all other forms in frequency of reports. The rectangle and the triangle were also somewhat higher in frequency than would be predicted by chance, while the diamond, cross and star were below chance expectancy. In regard to discrimination, the important factors appeared to be: area for the ellipses and triangle; maximum dimension for the rectangles and diamonds; and perimeter for the crosses and stars. To predict the relative discriminability of the average shape for the six basic forms used it would be best to compare their maximum dimensions. To make all 30 figures equally discriminable their perimeters should be equal.

CASPERSON, ROLAND CARL, and SCHLOSBERG, HAROLD. Monocular and binocular intensity thresholds for fields containing 1-7 dots. *J. exp. Psychol.*, 1950, 40, 81-92.

Studies the relation between light intensity and the number of dots perceived in a one degree field. The author suggests that the fact that it took progressively more light to see an increasing number of dots could be explained if it were assumed that the perception of each of several dots is an independent event and that the probabilities of each of the single events may be compounded to predict that of the group. With binocular as opposed to monocular vision a greater number of dots was seen.

CHALMERS, E. LAURENCE Jr. The role of brightness in primary size-distance perception. *Amer. J. Psychol.*, 1953, 66, 584-592.

Studies the role of brightness in size-distance judgments. Lighted fields in the shape of isosceles triangles were used. In monocular size-distance judgments, with extraneous cues eliminated, accommodation serves as a cue for objects closer than 10 feet; visual angle is the only cue for objects beyond 10 feet. For binocular size-distance judgments, as brightness is reduced, the visual angle of the object assumes greater importance relative to the visual cues of retinal disparity and convergence. As brightness is decreased, the threshold for the discrimination of depth increases. Using brightness levels of 25 and 0.025 foot Lamberts, increased variability of size-distance judgments was not found as brightness was reduced. However, judgments shifted from those based on the real physical size of the objects to those based on the visual angle of the object.

CHALMERS, E. LAURENCE Jr. Monocular and binocular cues in the perception of size and distance. *Amer. J. Psychol.*, 1952, LXV, 415-423.

Studies the role of binocular and monocular cues in size-distance judgments. The tactile-kinesthetic cues of monocular vision are not useful in judgment of size or distance of objects more than 25 feet away. Binocular cues are useful for only a few subjects for objects as much as 80 feet away. The author emphasizes the dependence of the results in size-distance studies on the nature of the apparatus and the procedure, the attitude and degree of sophistication of the observer, and the extent to which secondary cues have been controlled or eliminated.

CHAPANIS, A. Night vision--A review of general principles. *The Air Surgeon's Bulletin*, 1945, II, 279-284.

Presents a comprehensive summary of the facts and principles of night vision. Some of the material is out of date, but the article still contains much practical information.

CHEATHAM, PAUL G. Visual perceptual latency as a function of stimulus brightness and contour shape. *J. exp. Psychol.*, 1952, 43, 369-380.

Studies perceptual latency and perceptual development time as related to contour shape and changes in brightness. The test stimuli contours were a circle, triangle, square, and diamond. There was an inverse relationship between test stimulus brightness and perceptual latency. The time required for the complete development of the contour was inversely related to stimulus brightness. Unlike latency, it varied significantly with changes in contour shape. During the developmental period, the contour passes through an orderly sequence. A small portion appeared first, then increased in size, and finally became complete. Sides appeared before angles.

CHRISTENSEN, J.M., and CRANNELL, C.W. *The effect of selected visual training procedures on the visual form field.* WADC Technical Rep. 54-239, Wright Air Development Center, Air Research and Development Command, USAF, Wright-Patterson Air Force Base, Ohio, 1955.

Investigates the effect of tachistoscopic training on the improvement in reading, dial checking and a perimeter test (the Ferree-Rand Perimeter and Expo-Matic device). The results indicated that perceptual training with extremely simple stimuli is unlikely to result in a general improvement in form vision or in reading proficiency.

CLARK, BRANT. Night vision training: A summary of research and practice. In *Minutes and proceedings of the twenty-ninth meeting of the Armed Forces NRC Vision Committee.* U.S. Naval Submarine Base, New London, Conn., 1951, 199-211.

Evaluates military night vision training procedures in the United States, Canada and England. Basic principles were selected from military manuals on night vision training and discussions of night vision training. The literature on scotopic vision was then surveyed to evaluate the principles. Several training procedures were evaluated in the light of training objectives and research findings.

CLARK, W.C., SMITH, A.H., and RABE, AUSMA. The interaction of surface texture, outline gradient, and ground in the perception of slant. *Canad. J. Psychol.*, 1956, 10, 1-8.

Studies the effect of the complexity of surface texture gradient, outline gradient and ground on judgments of slant, object shape, and perspective shape. With monocular viewing, outline gradient was a more effective cue in the judgments than was surface texture, although the two together were no more effective than either one alone. The effects of ground were unclear, due to some interaction with the figure.

CLEMENT, DAVID E. Uncertainty and latency of verbal naming responses as correlates of pattern goodness. *J. verb. Learn. verb. Behav.*, 1964, 3, 150-157.

Studies indices of pattern uncertainty. Abstract patterns of dots and filled squares were used. Correlations between ratings of pattern goodness, uncertainties of verbal naming responses and latencies of these responses were significant at the .001 level. Since a single factor underlay the correlations it was inferred that the variables were concomitants of perceived pattern uncertainty.

COAN, RICHARD W. Factors in movement perception. *J. consult. Psychol.*, 1964, 28, 394-402.

Attempts to determine whether or not there is a general movement-perception factor. The following tests or procedures were used: (1) the Sixteen Personality Factor Questionnaire, Form A; (2) individual movement cards; (3) psychodrama; (4) phi phenomenon; (5) stick figures; (6) intermittent photic stimulation; (7) spiral movement aftereffect; (8) autokinetic phenomenon; and (9) a rod and frame test. The correlation matrix revealed no consistent tendency for different kinds of movement perception to covary. A general movement-perception factor was not found.

COHEN, WALTER. *Form recognition, spatial orientation, perception of movement in the uniform visual field. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Studies the effect on perception of exposure to an homogenous Ganzfeld. It was found that perceptual "blank-out" was associated with bursts of alpha activity on the EEG. It was further found that after a 90 second exposure to the homogenous field there was a decrement in form recognition. There was a greater loss of accuracy for difficult figures (star, cross, X, etc.) than for simple (circle, square, diamond, etc.) or moderately difficult ones (rectangle, T, L, etc.).

COHEN, WALTER, and TEPAS, DONALD. Temporal factors in the perception of verticality. *Amer. J. Psychol.*, 1958, LXXI, 760-763.

Studies the effect of prolonged exposure to a tilted rod and frame on judgments of verticality. Exposures up to four minutes increased significantly the errors in judgments. The effect was not present when subjects simply remained in the dark.

COLLIER, GEORGE, and VERPLANCK, WILLIAM S. Nonindependence of successive responses at the visual threshold as a function of interpolated stimuli. *J. exp. Psychol.*, 1958, 55, 429-437.

Studies the effect of the interpolation of stimuli of higher or lower brightness on threshold responses to successively repeated, simple, visual stimuli. Recent studies have shown that the threshold responses to successive stimuli of invariant brightness are not independent; yeses and noes occur in runs. The present study showed that the probability of a given response to a stimulus is a joint function of the magnitude of the current stimulus, the response to the preceding stimulus, and the relative magnitude of the proceeding stimulus. The response dependencies extend beyond one trial and probably are not attributable to sensitivity fluctuations.

CORBIN, H.H., REESE, E.P., REESE, T.W., and VOLKMANN, J. *Experiments on visual discrimination, 1952-1955.* Psychophysical Research Unit, Mount Holyoke College, South Hadley, Mass., Air Force Cambridge Research Center, TR No. 56-52, 1956.

Reports several experiments in visual search in which the stimuli were points of light. The relevant results were: (1) subjects can judge the mean, median, and range of distributions of position stimuli with considerable accuracy; (2) when subjects are required to locate a point of light after the light has disappeared and must delay their response for varying intervals of time, error and variability increase as the enforced delay in response time increases; (3) when subjects search a broad, blank, horizontal field for point-stimuli, they often miss those appearing at the sides. Under the experimental conditions used, a 120 degree field of search was the maximum effective size.

COULES, J.C. Effect of photometric brightness on judgment of distance. *J. exp. Psychol.*, 1955, 50, 19-25.

Studies the effect of photometric brightness on the judged distance of discs of light. For both monocular and binocular vision, the brighter an object, the closer it appeared to be. Changes in overall illumination had no consistent effect upon the judgment of distance. For binocular conditions, a brighter object farther away was equivalent to a nearer, dimmer object.

CRAIG, EUGENE A., and LICHTENSTEIN, M. Visibility-invisibility cycles as a function of stimulus-orientation. *Amer. J. Psychol.*, 1953, 66, 554-563.

Studies the effect of fixating a white visual field on the figural disappearance of a line radiating outward from the fixation point. The line disappeared subjectively at irregular intervals and for irregular durations during the five minute fixation periods. Maximal frequencies of disappearance occurred at 45°±15° from the horizontal and vertical main axes of the visual field, while minimal frequencies of disappearance occurred at the main axes ±15° The difference between these mean values was significant.

CRANNEL, C.W., and CHRISTENSEN, J.M. *Expansion of the visual form field by perimeter training* . USAF, WADC, TR 55-368, 1955, AD 99643.

Studies the effect of training on increasing the size of the visual form field. Subjects were given varied amounts of training in perceiving numbers at the periphery of their visual fields. They were then tested for the extents of their visual fields for forms. The results showed there was improvement in the ability to identify familiar stimuli presented farther and farther from the fovea but there was no transfer to other stimuli.

CROOK, DOROTHEA J., HANSON, JOHN A., McBRIDE, PATRICIA I., and WULFECK, J.W. *A bibliography on dark adaptation.* 1953.

Lists 417 references.

CRUMBAUGH, JAMES C. Temporal changes in the memory of visually perceived form. *Amer. J. Psychol.*, 1954, 67, 647-658.

Studies temporal changes in the remembered asymmetry of forms. The forms were two broken circles, a tilted line enclosed in a square, two discs, and an ellipse. The time intervals between the standard and variable targets ranged from 0.0 to 12.0 seconds. The results clearly showed temporally progressive changes in the traces. The changes observed differed in their pattern of development according to the particular form perceived. The traces of some forms progressed rapidly toward greater symmetry, while the traces of others showed an initial tendency toward decreased symmetry which soon was reversed.

CURRAN, C.R., and LANE, H.L. On the relations among some factors that contribute to estimates of verticality. *J. exp. Psychol.*, 1962, 64, 295-299.

Studies the effect of several variables on the perception of the vertical. Minimal visual cues had a dramatic effect in reducing nonveridical perception of the vertical. Removing these few visual cues by reducing illumination increased errors; e.g., reducing illumination by ½ increased errors by 100 times. Distortion of body tilt and balance produced effects of lesser magnitude. All the first and second order interactions of these variables had large and significant effects on perception of the upright.

DAVIS, D. RUSSELL, and SINHA, DURGANAND. The influence of an interpolated experience upon recognition. *Quart. J. exp. Psychol.*, 1950, II, 132-137.

Studies the recognition of a story where a picture illustrating part of the story is interpolated between the original hearing and the recognition test. On the recognition test, the subjects showed a tendency to prefer (to the original) a story which included details from the picture and, in a related study with recall, to omit details from the story which were not reinforced in the picture.

DAVISON, GERALD C. The negative effects of early exposure to suboptimal visual stimuli. *J. Pers.*, 1964, 32, 278-295.

Studies the effect of pre-recognition hypothesizing or guessing, stemming from suboptimal exposure of pictures, on the veridical perception of the pictures. The results confirm other findings that when presenting pictures or words with increasing clarity, correct identification was blocked by early guessing. The author suggests that nonveridical perception was related to constraint set-erroneous hypotheses. "Fresh looks" at the pictures appeared to break the set.

DAY, R.H. The physiological basis of form perception in the peripheral retina. *Psychol. Rev.*, 1957, 64, 38-48.

Discusses peripheral form perception and cites a number of relevant studies.

DAY, R.H. Application of the statistical theory to form perception. *Psychol. Rev.*, 1956, 63, 139-148.

The first part of the paper cites a number of early studies on the threshold for form which suggest that form perception is a three stage process; *viz* : (1) light threshold; (2) threshold for indefinite form; and (3) threshold for definite form.

DAY, R.H. The effect of size of target on accuracy of aim. *Amer. J. Psychol.*, 1954, 67, 659-667.

Studies the effect of target size on the accuracy of aim in a spearing test. Target sizes varied from one to six cm. In general, accuracy was greater with the larger targets. However, there was little difference between one and two cm. targets.

DEESE, JAMES. *Complexity of contour in the recognition of visual form.* Wright Air Development Center. WADC Technical Rep. 56-60, 1956.

Studies the relationship between complexity and recognition and also the effect of the number of forms presented before a recognition test on the complexity-recognition relationships. The stimuli used were regular forms composed only of right angles and irregular forms composed of obtuse and acute angles. Complexity was based on the number of angles in the form. The results showed: (1) for the regular forms, there were more errors with the simple figures than with the complex ones, but the reaction times were slightly longer for the complex figures; (2) for the irregular forms, there was no difference between simple and complex figures, but the reaction times were longer for the complex figures. In a second experiment, 1, 10, or 25 forms were presented and the subject then had to identify them from a group of 25. When a single form was presented first, complex figures were more accurately identified than simple ones. When 10 or 25 forms were inspected first, the effect was reversed.

DIAMOND, A.L, and GILINSKY, A.S. *Luminance thresholds for the resolution of visual detail during dark adaptation following different durations of light adaptation.* Columbia Univ., WADC, Technical Rep. 52-257, 1952.

The study shows that resolution of visual detail during dark adaptation is dependent upon the nature of the preceding light adaptation.

DOMEY, R.G., and McFARLAND, R.A. Dark adaptation threshold, rate, and individual prediction. *Night visibility 1961.* Highway Research Board Bulletin 298, Nat. Acad. Sci., Nat. Res. Council Publ. 925, 1961.

Studies the relation between dark adaptation and age. The authors conclude that there is a high correlation between age and dark adaptation thresholds; the correlation between age and dark adaptation thresholds tends to increase as time in the dark increases; and cone and rod thresholds are highly correlated.

DREVER, JAMES. Further observations on the relation between EEG and visual imagery. *Amer. J. Psychol.,* 1958, LXXI, 270-276.

Studies the assertion by Grey Walter and his associates that there are differences in alpha rhythm types which correspond to the kind of imagery most frequently used by subjects. Although there may be imagery types (persons whose imagery is primarily visual, as opposed to auditory and/or mixed) the results did not support the assertion that this is tied to alpha rhythym types.

DUNCAN, CARL P. Effect of self-satiation on perceived size of a visual figure, *J. exp. Psychol.,* 1960, 60, 130-136.

Studies the effect of prolonged fixation on the apparent size of a circle. The results showed that subjects who fixated to the left of the figure for two minutes either continuously or in cycles of 15 seconds fixation and 10 seconds rest chose a significantly smaller inspection figure than did control subjects.

DUNTLEY, SIEBERT Q. The visibility of distant objects. *J. Op. Society of Amer.,* 1948, 38, 237-249.

Discusses the chief variables involved in the visibility of an object and presents charts which permit the prediction of the visibility distance of uniformly luminous objects. The data necessary for these predictions are the contrast thresholds of the human observer, photometric data concerning the luminance of the object and its background, and the optical state of the atmosphere. Meterological conditions ranging from full daylight to overcast starlight are considered.

EASTERBROOK, J. A. The effect of emotion on cue utilization and the organization of behavior. *Psychol. Rev.,* 1959, 66, 183-201.

Discusses the role of emotion in cue utilization. The number of cues utilized in any situation tends to become smaller with increased emotion. On some tasks such reduction improves performance. Irrelevant cues are excluded and drive is then organizing or motivating. In other tasks, proficiency demands the use of a wide range of cues, and drive is disorganizing or emotional. There seems to be an optimal range of cue utilization for each task.

EDWARDS, A.S. The relation of light intensity to accuracy of depth perception. *J. app. Psychol.*, 1953, 37, 300-301.

Studies the effect of illumination level on the accuracy of depth perception. Twelve, fifty and 100 foot candles of illumination were used. Stimulus was 1½" by 2¼" rectangular light. The subjects were slightly more accurate with greater illumination. However, one-fourth of the subjects were more accurate with less illumination.

EDWARDS, WARD. Information and autokinetic movement. *J. exp. Psychol.*, 1959, 57, 89-90.

Tests the hypotheses that autokinetic movement occurs if the visual world is highly redundant and does not occur if the visual world is full of information. An orderly and an equivalent disorderly array of dots produced equal amounts and latencies of movement.

EDWARDS, WARD. Two- and three-dimensional autokinetic movement as a function of size and brightness of stimuli. *J. exp. Psychol.*, 1954, 48, 391-398.

Studies the effect of size and brightness on autokinetic movement. Stimuli as large as 7½ degrees and as bright as 174 foot Lamberts produced good autokinetic movement. The latency of movement increased and the amount decreased as size and, to a lesser degree, brightness increased.

ENGEL, GLORIA, and PARDUCCI, ALLEN. Value of background in the specification of the stimulus for judgment. *Amer. J. Psychol.*, 1961, LXXIV, 569-575.

Studies the effect of background size on size judgments. Both absolute and comparative judgments of the size of projected squares varied systematically with variation in background size.

ENOCH, JAY M. *Natural tendencies in visual search of a complex display. Visual search techniques*. Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Studies search techniques in terms of eye movements and fixations. Aerial maps were used as stimulus material. There were found to be two phases in the search pattern. In the orientation phase, the observer goes through a characteristic search pattern which is a spiral, up-down closing square. In the second or specific phase, the observer either expands his basic search pattern or goes to that area where he thought there were cues regarding the location of the object of the search. There seemed to be more coverage of the lower right hand quadrant and there was a marked concentration of fixations in the center of the display with a consequent exclusion of the borders. The optimum display size seems to be 9 degrees.

EPSTEIN, WILLIAM. Attitudes of judgment and the size-distance invariance hypothesis. *J. exp. Psychol.*, 1963, 66, 78-83.

Studies the effect of phenomenal, objective, perspective and projective judgmental attitudes on size and distance judgments of objects 10, 20, 30, 60 and 120 feet from the observer. The targets were isosceles triangles. The main results showed: (1) phenomenal, objective, perspective, and projective attitudes produced size matches which were veridical, overestimations, greater overestimations and underestimations, respectively; (2) deviations of size judgments varied with distance; (3) distance judgment did not vary for the different attitudes of size judgment. However, accuracy of distance judgment varied with the distance judged.

EPSTEIN, WILLIAM. The influence of assumed size on apparent distance. *Amer. J. Psychol.*, 1963, LXXVI, 257-265.

Studies the relation between assumed size and apparent distance. Photographs of coins were used. Under reduced viewing conditions, apparent distance was related to assumed size. With unimpeded binocular viewing, judgments of size and distance corresponded to objective size and distance.

EPSTEIN, WILLIAM, PARK, JOHN, and CASEY, ALBERT. The current status of the size-distance hypothesis. *Psychol. Bull.*, 1961, 58, 491-514.

Summarizes and discusses the experimental research which relates to the size-distance invariance hypothesis. The evidence suggests that the invariance hypothesis is unsound. Rather, as physical distance is increased, the physical size of the object is progressively overestimated. In regard to the known size-apparent distance hypothesis, the evidence suggests that changes in the assumed size of an object whose retinal size remains constant will result in appropriate changes in the apparent distance of that object.

EPSTEIN, WILLIAM, and ROCK, IRVIN. Perceptual set as an artifact of recency. *Amer. J. Psychol.*, 1960, LXXIII, 214-228.

Studies the role of expectancy and recency and frequency in the perception of ambiguous stimuli. The Schafer-Murphy ambiguous figure and a modification of Boring's "Wife and Mother-in-law" were used. The results showed that the immediately recent perceptual experience rather than expectancy controlled the final perception.

ERICKSON, R.A. Visual search performance in a moving structural field. *J.O.S.A.*, 1964, 54, 399-405.

Studies the detection of moving targets. The detection of moving targets decreases as the velocity of the target and the number of objects in the target area increases. A target near the center of the field, was more likely to be located. There was no correlation between observer age and search performance, but there was between foveal visual acuity and search performance. At low velocities, peripheral acuity is a better predictor of detection capability ; whereas, at higher velocities, foveal acuity is the better predictor.

ERIKSEN, CHARLES W. Discrimination and learning without awareness: A methodological survey and evaluation. *Psychol. Rev.*, 1960, 67, 279-300.

Examines the question of discrimination without awareness in the light of various methodologies. The author concludes that there is no convincing evidence that the human organism can discriminate or differentially respond to external stimuli that are at an intensity level too low to elicit a discriminated verbal report, and that verbal report is as sensitive an indicator of perception as any other response that has been studied.

ERIKSEN, CHARLES W. Object location in a complex perceptual field. *J. exper. Psychol.*, 1953, 45, 126-132.

Studies the rôle of target definition and field heterogeneity on the speed of locating targets in a large field of objects. The targets were circles, hexagons, diamonds, triangles, crosses, stars and squares. The results showed that multiply defined targets were located more quickly than targets defined on one dimension (form) only. For field heterogeneity (the number of ways the objects differed from one another), location was most rapid when the fields varied on hue; hue and form; hue, form, and brightness; and was slowest when the field was heterogeneous on hue, form, size, and brightness; and form, brightness and size.

ERIKSEN, CHARLES W. Location of objects in a visual display as a function of the number of dimensions on which the objects differ. *J. exp. Psychol.*, 1952, 44, 56-60.

Studies the speed of locating targets in a display when the classes of objects in the display differed from one another on only one or on two or three of the dimensions of form, hue, size, and brightness. For single dimensions, location time for hue differences was significantly faster than for form differences, and hue and form were both significantly faster than either brightness or size. The location times for the compounds of two and three dimensions were found to correspond to a weighted geometric mean of the single dimensions of which they were composed.

ERIKSEN, CHARLES W., and COLLINS, JAMES F. Investigation of the effect of a priming stimulus on backward masking. *Psychon. Sci.*, 1964, 1, 249-250.

Investigates the effect on backward masking of a priming stimulus given 100, 50, and 10 milliseconds prior to the form. Forms used were A, T, U, black on white, and subtending .2° of angle. Other research in the area is also cited. The priming stimulus had no effect. A ring following the brief exposure of a form by 100 milliseconds impaired recognition of the form. The same effect was found when the ring preceded the form. Since the greatest impairment in recognition was found when form and ring occurred concurrently, the authors suggest that masking may be due to the greater difficulty in recognition of a form surrounded by a black ring than a form appearing in an uncluttered white field.

ERIKSEN, CHARLES W., and HOFFMAN, MELVIN. Form recognition at brief durations as a function of adapting field and interval between stimulations. *J. exp. Psychol.*, 1963, 66, 485-499.

Studies the effect of the interval between stimulations and the luminance of the adopting field on form recognition. The letters A, T, and U were used. Recognizability was found to be a complex function of whether the form was followed or preceded by a flash of light, the lag time between stimulations, and the brightness of the adapting field.

ERLICK, DWIGHT E. The ability to filter noise from a visual task when the noise and signal are presented sequentially. *J. exp. Psychol.*, 1962, 63, 111-114.

Studies the ability to filter-out visual noise in a detection-recognition task. Signal-to-noise ratios ranged from one to twenty-two. Subjects judged the relative frequency of A and B letters presented visually when other letters were interspersed as noise. There were no significant differences between the several noise conditions and a no-noise condition.

EVELYN, K.A., CROCKER, B.F., HOLCOMB, R.K., JOHNSON, E.P., CROSSLAND, A.M., LATOUR, J.J.P.A., ELLIOT, A.J., and CHADWICK, M.C. *An outdoor study of night vision.* Nat. Res. Council, Canada, 1945.

Laboratory and field tests of visual acuity were made under illumination levels ranging from moonlight to starlight. Tests used were the Hecht-Schlaer adaptometer, a Snellen letter test and a contrast perception test. The results indicated large individual variability which seemed to stem from spontaneous variations in night visual acuity. The authors suggest that it is impossible to obtain accurate night vision assessments on the basis of a single trial with any test and that, even if a perfectly valid test were available, accurate assessments could be obtained only by taking the average of at least three scores.

FALK, JOHN L. Theories of visual acuity and their physiological bases. *Psychol. Bull.*, 1956, 53, 109-133.

Reviews concepts and theories of visual acuity.

FEINBERG, RICHARD. A study of some aspects of peripheral visual acuity, Parts I, II, III, and IV. *Amer. J. Optometry.* 1948 & 1949, XXVI, 49-56, & 105-118.

Studies photopic visual acuity at eight meridional positions of the retina at the following degrees of eccentricity; 0, 1, 3, 4, and 5. The data indicated that: (1) peripheral visual acuity decreases slowly as distance increases from the point of regard; (2) peripheral visual acuity seems to depend on the discrimination of linear extents rather than on discriminations of areal extent; (3) the variance of meridional peripheral acuity decreases as the distance away from the point of regard increases; (4) meridional positions show slight insignificant differences; (5) there is little evidence of a correlation between central and peripheral acuity; and (6) individual differences in maintaining levels of peripheral visual acuity are pronounced.

FINCH, D.M., CHORLTON, J.M., and DAVIDSON, H.F. *The effect of specular reflection on visibility, Parts I and II.* Project 52, Illumination Engineering Research Institute, Univ. of Calif., Berkeley, Calif., 1959.

Studies contrast and illumination levels as they relate to visibility. The research indicated that there is an optimal lighting arrangement for maximal contrast in a given situation and that this arrangement may be calculated in terms of specular and viewing angles. A technique for making contrast calculations is outlined by the authors. That such contrast control is important was revealed by other findings showing that when the physical contrasts of a task under two different lighting systems were equal, the visibility indices were also equal.

FITTS, P.M. *Studies of visual discrimination time: The time required to recognize simple patterns at equal distances from the eye, and patterns at alternately far and near distances.* USAF, WADC, AML, 1947, ASTI 8549.

Studies the time required for successive fixation and recognition of equally distant test objects and the time required for changing from far to near fixation. The results indicated that the time required for successive fixations varied with the amount of practice. For refixating far and near stimuli, practiced subjects required about 0.6 seconds.

FITTS, PAUL M., and SEEGER, CHARLES M. S-R compatibility: Spatial characteristics of stimulus and response codes. *J. exp. Psychol.*, 1953, 46, 199-210.

Studies the role of stimulus and response probabilities in information transfer. Light patterns were used as stimuli. The authors conclude that it is very difficult for subjects to learn to deal effectively with the uncertainties characteristic of a specific situation, if these uncertainties are different from the more general set of probabilities which have been learned in similar life situations.

FLAVELL, JOHN H., and DRAGUNS, JURIS. A microgenetic approach to perception and thought. *Psychol. Bull.*, 1957, 54, 197-217.

Discusses the development of percepts when the stimulus is presented with gradually increasing clarity. Initially, there is a diffuse, undifferentiated whole. Next, figure and ground become partially differentiated. This is followed by some distinctiveness of contour and inner content. Finally, full perception occurs. In the development of the percept, rational, objective characteristics replace inner, personal factors as determiners of structure.

FOLEY, P.J. The expression of certainty. *Amer. J. Psychol.*, 1959, LXXII, 614-615.

Studies subjects' verbal reports of recognition as these relate to the certainty of identification. In reporting the presence of stimulus A or B, the following words can be ranked in order of increasing subjective certainty: "suppose", "think", "sure", "certain", and "positive". It was also found that the words could be ranked in order of their decreasing ambiguity: "think", "suppose", "sure", "certain", and "positive".

FOLEY, P.J., LAVERY, J.J., and ABBEY, D.S. Scotopic acuity and knowledge of results. *Percept. mot. Skills.*, 1964, 18, 505-508.

In a study of the effect of practice on scotopic acuity, the authors conclude that improvement is the result of learning, and is specific to the stimulus used. No improvement takes place without specific knowledge of results, and the improvement does not transfer to new stimuli.

FOX, WYATT R. *Visual discrimination as a function of stimulus size, shape and edge gradient.* Boston Univ., Physical Research Laboratories, Technical Note No. 132, 1957, AD 141550.

Studies the role of stimulus characteristics on their detection and recognition thresholds. A circle, irregular shape, square, triangle, cross, and star were used in three foveal sizes and with three edge gradients for each size. For detection, the results showed: (1) increase in size decreased the threshold; (2) shape had little effect on threshold except for the irregular figure and the cross which had slightly higher thresholds; and (3) a decrease in the steepness of the edge gradient increased detection thresholds. For recognition the results showed: (1) increase in stimulus size decreased threshold and increased the frequency of correct responses; (2) the irregular figure and the cross had significantly higher thresholds than did the other figures (there were few "circle" responses to non-circular forms); and (3) a decrease in the steepness of the edge gradient increased the recognition threshold. The author points out that all investigations regardless of theoretical orientation agree that the contour of the figure is the cue for shape identification. He suggests that detection is largely a function of evaluating edges.

FREEDMAN, SANFORD J. *Sensory deprivation and perceptual lag.* WADD Technical Rep. 60-745, Aerospace Medical Division, Wright Air Development Division, Air Research and Development Command, USAF, Wright-Patterson Air Force Base, Ohio, 1960.

Studies the effect of a three hour sensory deprivation period on perceived speed. The illumination conditions were homogeneous, diffuse-light; blackout; and randomly changing visual stimulation. The results indicated apparent decreases in visual speed developed within 30 minutes under the homogeneous conditions. Randomizing the inputs greatly enhanced the apparent decrease.

FRENCH, ROBERT STANTON. Pattern recognition in the presence of visual noise. *J. exp. Psychol.*, 1954, 47, 27-31.

Studies the effect of visual noise as scattered points of light on the recognition of random dot patterns of varying complexity. Increasing the complexity of the target pattern by increasing the number of elements improved recognition performance. However, increasing the number of elements beyond seven or eight seemed to produce little if any further improvement. Increasing the complexity of the visual noise produced a progressive decrement in recognition of the target.

FRIED, R. Monocular and binocular comparison of apparent size. *Amer. J. Psychol.*, 1964, LXXVII, 476-479.

Studies the apparent length of a line segment viewed monocularly and binocularly. The results showed that the line had to be longer when viewed monocularly to be judged equal to a line of identical length viewed binocularly. Judgments made by the non-dominant eye were nearer those made binocularly.

FRY, GLENN. The relationship between perceived size and perceived distance in the periphery. *Amer. J. Optometry*, 1956, 477-482.

Studies the overestimation of the size and distance of objects viewed in the peripheral as opposed to the central visual field. Checkerboard targets were used. The results showed a progressive distortion of outer squares as they were placed further from the line of sight. The author concludes that peripheral vision is a reliable indicator of the presence of an object but is not adequate for size or spatial relationship judgments.

FRY, G.A., BRIDGMAN, C.S., and ELLERBROCK, V.J. The effects of atmospheric scattering on binocular depth perception. *Amer. J. Optometry*, 1949, 26, 9-15.

Studies the effect of contrast reduction (veiling glare) on apparent distance. A dark rectangular target on a background of constant brightness was used. Decreases in contrast produced increases in the apparent distance of targets. This effect was not overcome by training.

GAITO, JOHN. Visual discrimination of straight and curved lines. *Amer. J. Psychol.*, 1959, LXXII, 236-242.

Studies the visual threshold for straight and curved lines. Although there is lack of agreement, the majority of experimental studies show that straight line forms (squares, rectangles, triangles) are more readily perceived than curved line forms. The results of the present study showed that straight lines, as such, are more readily perceived than curved lines.

GARNER, W.R. *Uncertainty and structure as psychological concepts.* John Wiley & Sons, New York, 1962.

In regard to the perception of visual pattern, the author suggests that the perception is based on an inferred subset to which the pattern belongs rather than on the specific characteristics of the pattern.

GARNER, W.R., and CREELMAN, C. DOUGLAS. Effect of redundancy and duration on absolute judgments of visual stimuli. *J. exp. Psychol.*, 1964, 67, 168-172.

Studies the effect of size, hue, or size and hue combined and duration of exposure on the absolute judgments of stimuli. Judgments were for size, hue, and brightness. Squares of Munsell paper were used. The results showed improved discrimination when size and hue were combined. There were no differences between exposure times of 0.04 seconds and 0.10 seconds.

GAYDOS, HENRY F. Intersensory transfer in the discrimination of form. *Amer. J. Psychol.*, 1956, 69, 107-110.

Studies the transfer in discriminations learned visually and tactually. The stimulus objects were random curved-edge shapes 1/8 inch thick and about 2 inches in their greatest dimension. Using a relearning method, the results showed there was considerable transfer. Initial learning by touch had a greater positive effect on visual recognition than when the conditions were reversed.

GEMELLI, AGOSTINO. The visual perception of movement. *Amer. J. Psychol.* 1958, LXXI, 291-297.

Studies the perceived speed of objects (a disc) moving in different directions in the visual field plane. The results showed that when the object moves from left to right, the movement is considered swifter than when it moves from right to left. The speed of an object moving quickly upward is considered less than the speed of an object moving slowly downward. Vertical movements, whether downward or upward, seem swifter than horizontal movements.

GEORGE, F.H. Errors of visual recognition. *J. exp. Psychol.*, 1952, 43, 202-206.

Studies the effect of post-exposure delays on the recognition of forms. Incomplete circles, arrows, and ellipses and time intervals of 5 min., 24 hrs., 4 days, and 8 days were used. The results showed that there is no observable progressive change in recognition as is predicted by the principle of Prägnanz.

GERATHEWOHL, SIEGFRIED J., and TAYLOR, WILLIAM F. Effect of intermittant light on the readability of printed matter under conditions of decreasing contrast. *J. exp. Psychol.*, 1953, 46, 278-282.

Studies the effect of flicker on the readability of printed material. Four different light-dark ratios and two flicker frequencies of 9 and 15 cps were used. The effect of flicker was to lower the number of lines read especially at low illumination levels. It seems doubtful that flicker can be used for the improvement of visibility under conditions of low contrast.

GIBSON, ELEANOR J. Improvement in perceptual judgments as a function of controlled practice or training. *Psychol. Bull.*, 1953, 50, 401-431.

A review article which cites relevant material relating to the effect of training and performance on visual acuity and judgments of space, speed, and form.

GIBSON, ELEANOR J., and BERGMAN, RICHARD. The effect of training on absolute estimation of distance over the ground. *J. exp. Psychol.*, 1954, 48, 473-481.

Studies the effect of practice on the estimation of distance in an outdoor setting. Rectangular targets and distances up to 395 yards were used. The results showed: (1) improvement in absolute judgments of distance occurred as a result of training; (2) training tended to correct constant errors of both over- and under-estimation.

GIBSON, ELEANOR J., BERGMAN, RICHARD, and PURDY, JEAN. The effect of prior training with a scale of distance on absolute and relative judgments of distance over ground. *J. exp. Psychol.*, 1955, 50, 97-105.

This study is related to the previous one. Among other findings, the results showed clearly that preliminary training with a scale of distance improves absolute estimation of the distance to an unfamiliar target in a new location.

GIBSON, JAMES J., and FLOCK, HOWARD. The apparent distance of mountains. (Notes and discussions.) *Amer. J. Psychol.*, 1962, LXXV, 501-503.

Relates the apparent nearness of distant mountains to an alteration or reversal in the customary angular size gradient in that terrain features near a mountain may be larger than nearer ones.

GILCHRIST, J.C., and NESBERG, LLOYD D. Need and perceptual change in need-related objects. *J. exp. Psychol.*, 1952, 44, 369-376.

Studies the effect of hunger and thirst on the illuminance matches of projected pictures of food and liquid-related objects. The results showed that increasing need produced increasingly positive time errors in the illuminance matches of objects relevant to the need.

GILINSKY, A.S. Perception of size of objects at various distances. *Res. Bull.,* AFPTRC-TR-5-92, 1954, AD 63041.

Studies the effect of objective vs. retinal instructions on size matches with the standard stimulus 100 to 4000 feet distant. The targets were white triangles. Objective instructions resulted in size matches which increased with distance, exceeding size constancy. Retinal instructions resulted in matches which decreased with increasing distance but which tended to overestimate the retinal size.

GOGEL, WALTER C., and HARKER, GEORGE S. The effectiveness of size cues to relative distance as a function of lateral visual separation. *J. exp. Psychol.,* 1955, 50, 309-315.

Studies the effect of lateral visual separation on the apparent depth between two differently sized playing cards. The average apparent depth between the cards increased with increases in lateral separation. The changes did not occur when the cards were the same size. The authors conclude that the effectiveness of size cues to relative depth is directly related to the lateral separation of the differently sized cards.

GOGEL, WALTER C., WIST, EUGENE R., and HARKER, GEORGE S. A test of the invariance of the ratio of perceived size to perceived distance. *Amer. J. Psychol.,* 1963, LXXVI, 537-553.

Studies the interrelation of perceived absolute size and perceived absolute distance using three values of effective interpupillary distance. Black rectangular targets were used. Perceived absolute size and perceived absolute distance were positively correlated. The ratio of perceived absolute size to perceived absolute distance varied as a function of both interpupillary distance and physical distance.

GOLDFARB, J.L., and GOLDSTONE, S. Properties of sound and the auditory-visual difference in time judgment. *Percept. mot. Skills,* 1964, 19, 606.

The study confirmed previous findings that sound durations are judged to be longer than light durations. White sound and white light were used.

GOLDMAN, ALFRED E. Studies in vicariousness: Degree of motor activity and the autokinetic phenomenon. *Amer. J. Psychol.,* 1953, 66, 613-617.

Tests the hypothesis that under conditions of inhibition of motor movement, perceptual activity will increase and conversely, with increased motor movement, perceptual activity will decrease. The results indicated that the greater the degree of motor involvement, (1) the longer the time for the appearance of autokinetic movement, (2) the shorter the duration of its first uninterrupted phase, and (3) the less complex its pattern of movement.

GOLDSTEIN, ALVIN G. Familiarity and apparent complexity of random shapes. *J. exp. Psychol.*, 1961, 62, 594-597.

Studies the relation between stimulus familiarity and judgments of complexity. Random shapes of matched physical complexity were used. Those shapes with which subjects had been familiarized were judged to be significantly less complex than the unfamiliar ones.

GOLDSTEIN, ALVIN G. On the use of the term "recognition". *Amer. J. Psychol.*, 1958, LXXI, 790-791.

The author points out that the difficulty or failure in recognizing forms, when their orientation varies from the normal one, holds only for forms which have one particular normal orientation. The adverse effect does not apply to forms customarily seen in many or all possible orientations.

GOLDSTEIN, ALVIN G. Judgments of visual velocity as a function of length of observation time. *J. exp. Psychol.*, 1957, 54, 457-461.

Studies the effect of various physical velocities and exposure times on judged velocity. The velocities were 2.4, 4.8, or 14.3 cm. per second. In general the results showed that there was a decrease in apparent velocity with an increase in observation time; from 2 to 8 sec. of observation little change occurred; from 8 to approximately 30 sec. of observation apparent velocity decreased; and from 30 to 60 sec. of observation there was no change or a slight tendency for apparent velocity to increase.

GOLDSTONE, SANFORD, and GOLDFARB, JOYCE LEVIS. Direct comparison of auditory and visual durations. *J. exp. Psychol.*, 1964, 67, 483-485.

Compares the judged durations of lights and sounds. Duration of the standard stimulus was 1.0 second and duration of the variable ranged from 0.6 to 1.4 seconds. The results showed that auditory durations were judged longer than visual and visual durations were judged shorter than auditory. In an earlier study, the senior author had demonstrated that a visual "second" was consistently longer than an auditory "second".

GOLLIN, EUGENE S. Developmental studies of visual recognition of incomplete objects. *Percept. mot. Skills*, 1960, 11, 289-298.

Compares four and five year old children and adults for the recognition of line drawings of common objects under conditions of reduced cues and studies the effect of training on recognition. The results showed that children required greater completeness of representation than did adults. Limited training on intermediately complete representations was very effective in improving recognition scores of all groups on greatly reduced representations.

GORDON, DONALD A. *Visual detection and identification: Military applications.* Memorandum of Project MICHIGAN 2144-397-R, Univ. of Michigan, Willow Run Laboratories, Ann Arbor, Michigan, 1959.

Discusses the meaning of detection and identification as they relate to military problems. Military detection is a kind of identification which implies the object is not a textural detail of ground, foliage, sea, or sky, but something man-made and not usually seen in that position. Identification implies a unique specification of the object. Identification occurs at shorter distances than does detection and is bounded by detection distance which is bounded by acuity threshold distance. Laboratory thresholds which are obtained under ideal conditions may not apply in the field.

GORDON, DONALD A. *A survey of human factors in military night operations (with special application to armor)*, Special Report 11, US Army Armor Human Research Unit, Ft. Knox, Ky., 1957.

Reviews the scientific and technical literature dealing with human factors in night military operations, primarily for its applicability to problems of night Armor operations. The following topics are covered: (1) night vision training for Armor personnel; (2) night sights and optical systems; (3) battlefield illumination; (4) some additional problems of night combat; and (5) applications of research to night operations.

GORDON, DONALD A. *A survey of human factors in military night operations (with special application to armor)*, Special Report 11, Human Resources Research Office, 1957.

Compares form, motion, and displacement thresholds in the peripheral retina at a scotopic brightness level of 0.0001 millilamberts. The stimulus object was a modified Landolt ring. The findings of the study were summarized as follows: As the peripheral angle increases, the threshold for form at first decreases slightly, reaching its lowest point at about 5° to 7° from the fovea and rises at an accelerating rate out to 50° of peripheral angle. Near the fovea, the photopic form-threshold is much lower than the scotopic threshold. At wider peripheral angles, both threshold functions rise, the divergence between the two decreasing out to about 50° of peripheral angle. The motion-threshold rate is proportional to the form threshold size at all retinal positions.

GORDON, DONALD A, et al. *Validation of personnel measures against combat performance of enlisted men in Korea.* Department of the Army, PRS Report 942, Personnel Research and Procedures Branch, AGO, 1952.

Studies the relation between ratings on combat performance in Korea and scores on tests of visual acuity. The Armed Forces Far Visual Chart (photopic) and the Ortho-Rater (photopic, mesopic, and scotopic) were used. None of the acuity scores was significantly correlated with combat ratings.

GORDON, D.A., and LEE, G.B. *Model simulator studies: visibility of military targets as related to illuminant position,* Project MICHIGAN, Vision Research Laboratories, Univ. of Michigan, 1959.

Studies the effect of illuminant position at various azimuths and at various elevations through the median plane on the detection and identification of objects in a miniature battlefield. Detection and identification were relatively good at 18 degrees, 90 degrees, and 135 degrees, and best at 180 degree source azimuth. Detection and identification were fair at 5 degree elevation, poor at 45 degrees, and continuously better through 90, 135, and 175 degrees. At 175 degrees elevation the targets could be detected at 3.5 times the distance that they could be with the source at 45 degrees elevation. Identification distance was about 2.5 times better.

GOTTSDANKER, ROBERT. How the identification of target acceleration is affected by modes of starting and of ending. *Brit. J. Psychol.,* 1961, 52, 155-160.

Studies the ability to differentiate accelerated and constant velocity motion. The conditions were negatively and positively accelerated motion differing in a sudden vs. lead-in start and a visible termination vs. termination behind a screen. The lead-in onset increased correct responses to positively accelerated motion. Negatively accelerated motion was identified more accurately than was positively accelerated motion. With lead-in onset and visible termination, both kinds of acceleration were equally identifiable.

GOTTSDANKER, ROBERT M. The role of form discrimination in the perception of motion. In Joseph W. Wulfeck, and John H. Taylor (Eds.), *Form discrimination as related to military problems.* Armed Forces, NRC Committee on Vision, Nat. Acad. Sci., Nat. Res. Council Publ. 561, 1957, 127-129.

Discusses some of the findings regarding the perception of motion: (1) motion thresholds are higher when background objects are absent than when they are present; (2) apparent velocity is lower in peripheral than in central vision; (3) there is a breakdown of contour with motion across the retina; (4) the best background for identifying acceleration is random texture; and (5) identification was poorest when starting and end points were not seen.

GRUBER, HOWARD E., FINK, CHARLES D. and DAMM, VERNON. Effects of experience on perception of causality *J. exp. Psychol.,* 1957, 53, 89-93.

Uses a Michotte type situation to study the effect of a temporal delay between events and a physical gap between stimulus components on the perception of causality. The stimulus event was the collapse of a "bridge" or horizontal bar. The temporal delay was between removal of an upright and falling of the bar, and the physical gap was between the upright and the bar. With neither a delay or gap almost all subjects reported striking impressions of causality. Under less favorable conditions, the impression of causality was accompanied by reports of cognitive activity to account for the delays or gaps.

GULICK, W.L., and STAKE, R.E. The effect of time on size-constancy. *Amer. J. Psychol.*, 1957, LXX, 276-279.

Studies the effect of exposure time on size-constancy. With exposure times of 0.1, 0.8 and 4.0 seconds, subjects made size estimates of triangles at 20, 30, 40, and 80 feet. Cues were limited to accomodation, convergence, and retinal disparity. The results indicated that exposures as brief as 0.1 second adversely affected size-constancy.

HABER, RALPH NORMAN, and HERSHENSON, MAURICE. Effects of repeated brief exposures on growth of a percept. *J. exp. Psychol.*, 1965, 69, 40-46.

Studies the effect of successively repeated brief exposures of a word on the perception of the word. The results showed that the probability of perceiving a word increases with exposure trials and that the probability of perception was always higher for a single flash at a given duration than for two or more shorter flashes summing to the same total duration.

HAKE, H.W. *Contributions of psychology to the study of pattern vision.* WADC No. 57-621, 1957, AD 142035.

Reviews the contributions of psychology to the study of visual pattern or form perception. Part I deals with the description of some of the general characteristics of the visual system. Part II covers the traditional topics of form perception (332 references).

HAKE, HAROLD W., and ERIKSEN, CHARLES W. Role of response variables in recognition and identification of complex visual forms. *J. exp. Psychol.*, 1956, 52, 235-243.

Studies the effect of practice with irrelevant labels on later learning to associate these with unfamiliar nonsense forms. The forms were patterns of light. Prior practice increased correct labeling and recognizing the forms in the set, but it did not increase the ability to recognize the forms when seen together with new forms of similar constructions.

HALL, K.R.L. The effect of names and titles upon the serial reproduction of pictorial and verbal material. *Brit. J. Psychol.*, 1950, XLI. 109-121.

Studies the effect of names and titles on the serial reproduction of pictorial and verbal material. Bartlett's findings were confirmed. Primarily, the effect of names and titles, whether impeding or aiding adequate recall, varied with the relevance of the names and titles to the figural material.

HALL, ROBERT J., et al. *A study of visual display enhancement and techniques of color filtering.* Technical Documentary Rep. No. ESD-TDR-63-635, Decision Sciences Laboratory, Electronic Systems Division, AF Systems Command, USAF, L.G. Hanscom Field, Bedford, Mass., 1963.

Studies the effect of spectral partitioning of light energy, observer opportunity to manipulate viewing conditions, and previous information about the targets on target detection. The targets were black and white photographs of colored Attneave-like forms, some of which were taken without filters and some through blue or orange-yellow filters. One group of subjects viewed the unfiltered photographs. A second group viewed the two filtered photographs singly or superimposed at will, and the third group could view them alternately with the experimenter doing the switching after a three second pause. Detection was significantly improved by both the filtering techniques, and observer control of target presentation showed an insignificant improvement over experimenter control. Seeing examples of the targets significantly decreased false reports, but there was little increase in the number of targets detected.

HALL, ROBERT J., and WILSONCROFT, W.E. Prolonging visual after-images. *Psychon. Sci.*, 1964, 1, 267-268.

Studies the effect of a flickering on-off light following initial stimulation on the duration of visual after-images. The results showed that the flickering light following initial stimulation of the retina prolonged the after-images.

HAMILTON, CHARLES E. *Model simulator studies of the visibility of military targets at night.* ERI Project 2699, Contract No. DA-49-106-qm-1, Subcontract No. HumRRO-1-003, 1958.

Studies the effect of terrain, illumination level and searchlight displacement on the detection and identification of military vehicles under nighttime conditions. A scale model simulator was used. Detection distances are given for the various targets and conditions. Poorest visibility occurred with the targets against a tree background for short durations of illumination with the searchlight not displaced from the observer.

HAMMER, MORTON. The role of irrelevant stimuli in human discrimination learning. *J. exp. Psychol.*, 1955, 50, 47-50.

Investigates the question of whether or not the subject learns not to attend the irrelevant stimuli in discrimination training. The stimuli were capitalized consonants. A transfer of training design was used. The transfer of irrelevant stimuli from the first to the second problem did not significantly affect the subject's performance; there was no evidence that responses of any sort were acquired to the irrelevant stimuli during discrimination training.

HANES, R.M. Some effects of shape on apparent brightness. *J. exp. Psychol.*, 1950, 40, 650-654.

Studies the effect of shape on the apparent brightness of squares, triangles and circles exposed at intensity levels of 0.1, 10.0 and 100 millilamberts. With areas controlled, the triangle appeared brighter than the circle and square for the smaller sizes. For the largest sizes, the circle appeared brighter.

HANES, R.M. A scale of subjective brightness. *J. exp. Psychol.*, 1949, 39, 438-452.

Studies the reliability of estimates of apparent brightness for various hues at luminance intensities ranging from 0.0001 to 100 millilamberts. The results showed fairly consistent estimates and only a reasonable amount of error. Neither hue nor stimulus duration had an appreciable effect on the judgments.

HANSON, JOHN A. Effects of certain pre-exposure variables on dark adaptation. In Robert Heath Brown (Ed.) *Illumination and visibility of radar and sonar displays*. Armed Forces, NRC Committee on Vision, Nat. Acad. Sci., Nat. Res. Council Publ. 595, 65-70, 1958.

Studies the effect of pre-exposure on subsequent dark adaptation. Pre-exposure for 100 foot-lambert-seconds or less impairs peripheral, but not foveal sensitivity.

HARCUM, E.R. Interactive effects within visual patterns on the discriminability of individual elements. *J. exp. Psychol.*, 1964, 68, 351-356.

Studies the question of whether accuracy for individual elements of a tachistoscopic pattern of open and blackened circles is determined by relative position within the pattern or by absolute position on the retina. The patterns were exposed horizontally across fixation. The results indicated that accuracy depended upon interaction among the elements and relative position within the pattern rather than upon retinal position.

HARCUM, E.R. *Detection versus localization errors on various radii of the visual field. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Reports two experiments to test the hypothesis that detection sensitivity is best for the horizontal axis and that localization accuracy is best for either the vertical or horizontal axis and worst for the diagonal axis. Radial localization was found to be better for both horizontal and vertical axes than for diagonal ones. Reference is made also to other experiments which have shown that for eccentric fixations detection, form threshold, visual numerosity and, in certain cases, visual acuity, have lower thresholds along the horizontal than the vertical axes.

HARCUM, E.R., and DYER, DOROTHY W. Monocular and binocular reproduction of binary stimuli appearing right and left of fixation. *Amer. J. Psychol.* 1962, LXXV, 56-65.

Studies the accuracy with which subjects reproduce patterns of open and darkened circles presented in the left and right halves of the visual field. The results showed superior accuracy for the elements to the left of fixation. The authors suggest that this is a learned tendency.

HARRIS, JAMES L. *Factors to be considered in developing optimum visual search. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Discusses the parameters of the visual detection lobe and suggests that these are: (1) adaptation level; (2) target size, shape and pattern; (3) fixation period; (4) field factors; and (5) atmospheric transmission.

HARRISON, J.M., and PHOENIX, C.H. *The effect of visual angle and degree of imperfection upon the recognition of objects.* USAF, WADC, Technical Note 104, 1953, AD 20410.

Studies the effect of visual angle, background element size, and the ratio of target area to background element area on recognition. Targets were semicircles and isosceles triangles superimposed upon a grid of squares painted black and white in such a way as to partially confound target contours. As the target area-background element area ratio increased, correct recognition increased when the visual angle was between 25 and 159 minutes of arc. When visual angle was less than 25 minutes there was improved recognition for those target-element ratios in which there had not been perfect recognition at the 25 to 159 degree angle.

HARTMAN, A.M. Effect of reduction on the relationship between apparent size and distance. *Amer. J. Psychol.*, 1964, LXXVII, 353-366.

Studies the effect of reduced size and distance cues on size and distance judgments. Square black targets were used. With monocular viewing, the results supported the size-distance invariance hypothesis.

HARWAY, NORMAN I. The judgment of distance in children and adults. Paper presented at the 1962 EPA convention.

Studies distance judgments in children and adults in an outdoor mowed field. Distances ranged from 10 to 65 feet. The children were 5, 7, 10, and 12 years of age. Adults made judgments while standing and kneeling. The results showed no statistical difference in the accuracy of estimation at the two heights, nor for the adults and 12 year olds. At all distances, the correct distance was underestimated by about 30 percent by all groups.

HAVENS, LESTON L., and FOOTE, WARREN E. The effect of competition on visual duration threshold and its independence of stimulus frequency. *J. exp. Psychol.*, 1963, 65, 6-11.

Studies the effect of prior word usage on visual duration thresholds. Tachistoscopically presented words were used. The authors conclude that duration thresholds are not primarily a function of the frequency of prior usage of stimuli but of the ability or inability of the stimuli to evoke high frequency competitive responses.

HEBB, D.O., and FOORD, ESME N. Errors of visual recognition and the nature of the trace. *J. exp. Psychol.*, 1945, 35, 335-348.

Uses the method of recognition and testing of different subjects rather than the method of reproduction and testing of the same subjects to study the Gestalt assertion of dynamic changes within the memory trace. Stimuli used were circles with gaps of increasing size, and arrowhead designs with decreasing sharpness of angle. The results did not support the Gestalt hypothesis and the authors suggest that supportive evidence is found only when the method of repeated reproduction is is used.

HEINEMANN, ERIC G., TULVING, ENDEL, and NACHMIAS, JACOB. The effect of oculomotor adjustments on apparent size. *Amer. J. Psychol.*, 1959, LXXII, 32-45.

Studies the effect of changes in convergence without changes in accommodation or pupil size on apparent size. The target was a one degree disc. Changes in convergence were a sufficient condition for the occurrence of changes in apparent size. Changes in accommodation and pupillary diameter were not necessary conditions.

HELD, H.H. Peripheral acuity. *Brit. J. Physiol. Optics*. 1959, 16, 126-143.

Presents a critical survey and discussion of some of the current literature dealing with peripheral visual acuity. The second part of the paper presents an experiment on the effects of blur on peripheral acuity which shows that acuity decreases as blur increases.

HELSON, H. Adaptation-level as a basis for a quantitative theory of frames of reference. *Psychol. Rev.*, 1948, 55, 297-313.

Discusses the adaptation level as a basis for a theory of frames of reference. The author suggests that in addition to the physical value of the stimulus there are three adaptation factors which determine the judged value of the stimulus. These are: (1) the physical values of the other stimuli in the series being judged; (2) background stimuli present at the time of judgment; and (3) subject's past experience with similar stimuli.

HENNEMAN, RICHARD H. *Factors determining the identification of ambiguous visual stimuli. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Studies the question of whether, for ambiguous stimuli, subjects come to depend more upon the probabilities of previous stimulus occurrence than upon the actual physical properties of the stimuli. It was found that: (1) identification becomes increasingly difficult as the stimulus becomes increasingly distorted or ambiguous; (2) with greater distortion, there are a greater number of "probability" errors; and (3) identification improves with practice, although more so for moderately distorted stimuli than for slight or severly distorted ones.

HENNEMAN, RICHARD H. *The effect of irrelevant information upon complex visual discrimination.* Form discrimination as related to military problems. Nat. Acad. Sci., Nat. Res. Council Publ. 561, 1957.

Studies the effect of irrelevant information on visual discrimination. A "zero irrelevant" condition, a "never relevant" condition in which irrelevant dimensions were always irrelevant, and a "sometimes relevant" condition in which the secondary dimension was sometimes relevant were used. Stimuli were geometrical figures. With the "sometimes relevant" condition there was an insignificantly higher latency response than with the other two conditions. In a second experiment, two, four, and six irrelevant stimulus dimensions were used in the "sometimes relevant" condition. Although there were differences in error scores in early trials, they disappeared with practice. Response latency scores, however, were statistically different over all trials.

HERON, W., DAANE, B.K., and SCOTT, T.H. Visual disturbances after prolonged perceptual isolation. *Canad. J. Psychol.*, 1956, 10, 13-18.

Studies the effect of prolonged perceptual isolation on visual functioning. After six days of perceptual deprivation the observers found: (1) fluctuations, drifting and swirling of objects in the visual field; (2) the position of objects seemed to change with head and eye movements; (3) shapes, lines and edges appeared distorted; (4) after-images were accentuated; and (5) colors were very bright and saturated and contrast phenomena were enhanced. Hallucinatory activity started after the first day of isolation becoming more and more complex the longer the Ss remained in isolation.

HESSON, JAMES M., and THOMAS, FRANCIS H. *Training materials for aerial observer instruction in basic visual skills.* Supplement to HumRRO Technical Rep. 80, Low altitude aerial observation: an experimental course of instruction. US Army Aviation Human Research Unit, Ft. Rucker, Alabama, 1962.

Presents material designed to assist the unit training officer in developing and presenting a complete training program in the basic skills of aerial observations. Topics covered are visual search techniques, recognition training, geographical orientation and target location.

HICK, W.E. The threshold for sudden changes in the velocity of a seen object. *Quart. J. exp. Psychol.*, 1950, II, 33-41.

Determines the difference threshold for the velocity of a moving object (a short segment of a line on a band of paper passing over a drum). The method of constant stimuli was used. Under favorable conditions, the mean threshold was about 12% of the initial velocity with the thresholds increasing at both extremes. Exposure time as short as 0.5 seconds had no appreciable effect on the thresholds.

HILL, CHARLES W. Perceptual judgment as a function of mental set, anchoring point, and method of judgment. *J. exp. Psychol.*, 1953, 46, 325-328.

Studies the interacting influences of a visual anchoring point and a conflicting suggestion-induced set on the formation of a scale of perceptual judgment. Geometric line patterns were used. The author concluded that a mental set may be a strong determining factor in the perception and judgment of an unstructured situation; the presence of an anchoring point may help in stabilizing the perceptions and judgments but its influence should not be taken for granted.

HILLIX, W.A. Visual pattern identification as a function of fill and distortion. *J. exp. Psychol.*, 1960, 59, 192-197.

Attempts to determine the characteristics of a stimulus which makes its identification difficult. Grid patterns with varying amounts of fill and distortion were used. The author concludes that perceptual difficulty depends not only on the absolute characteristics of the stimulus but also to a very great extent on the amount of distortion in the stimulus.

HIRSH, IRA J., and SHERRICK, CARL E. Jr. Perceived order in different sense modalities. *J. exp. Psychol.*, 1961, 62, 423-432.

Studies the relation between the temporal separation of stimuli and their perceived order of occurrence. Regardless of the sense modality, two events must be separated by about 20 milliseconds in order for the subject to correctly identify the temporal order. In order for the subject to perceive that successive stimuli are successive rather than simultaneous, the temporal interval is shorter and appears to depend on the particular sense modality.

HOCHBERG, JULIAN E. *Form and visual detection.* Form discrimination as related to military problems. Nat. Acad. Sci., Nat. Res. Council Publ. 56, 1957.

Discusses methods of research on form detection. The author points out that forms can be concealed by hiding or occluding parts of the contour or by camouflage in which parts of the contour are "appropriated" by other forms by means of the Gestalt principle of good continuation.

HOCHBERG, JULIAN, and BROOKS, VIRGINIA. Effects of previously associated annoying stimuli (auditory) on visual recognition thresholds. *J. exp. Psychol.*, 1958, 55, 490-491.

Studies the effect of pairing an annoying stimulus with visual forms on their later recognition. The visual recognition brightness contrast thresholds for polygons concealed in more complex test patterns was raised when an annoying auditory stimulus was previously paired with the polygons.

HOCHBERG, JULIAN, and McALISTER, EDWARD. A quantitative approach to figural "Goodness". *J. exp. Psychol.*, 1953, 46, 361-364.

Suggests that a quantitative index of figural goodness is the probability of alternate perceptual responses and that the probability of a given perceptual response to a stimulus is an inverse function of the amount of information required to define that pattern. Tri- and bi-dimensional Kopfermann cube figures were used.

HODGE, MILTON H. The influence of irrelevant information upon complex visual discrimination. *J. exp. Psychol.*, 1959, 57, 1-5.

Studies the effect of irrelevant information on complex discrimination performance. The stimuli were complex geometric forms which could be varied along 10 dimensions, such as form, size, color, etc. The results suggest that increasing amounts of irrelevant information is detrimental providing the irrelevant information is at other times relevant.

HOISINGTON, L.B., and SPENCER, CAROL. Specific set and the perception of "subliminal" material. *Amer. J. Psychol.*, LXXI, 263-269, 1958.

Studies the effect of the introduction of a specific set on the perception of familiar verbal material which is presented at below perceptual threshold level. The results showed that appropriate experimental instructions had the same effect as that produced by increased stimulation.

HOPKIN, V.D. *A selected review of peripheral vision.* Flying Personnel Research Committee, Institute of Aviation Medicine, Royal AF, Farnborough, England, 1959.

Reviews the literature on peripheral vision and suggests that in spite of considerable lack of agreement, the following tentative conclusions may be drawn: (1) there is a rapid loss of peripheral acuity from the center of the visual field outwards; (2) this loss is not the same in all four meridians; (3) there is a substantial fluctuation in peripheral acuity, independent of practice or other factors; (4) there is no agreement on the area of maximum acuity in the periphery; (5) peripheral acuity improves with dark adaptation and with practice; (6) reaction times are longer for peripheral stimuli than for central stimuli; (7) light or movement in the periphery may be detected without any perception of form; and (8) a subject may be able to perceive the outline of a moving peripheral object without being able to perceive its interior detail.

HOWARTH, C.I., and BULMER, M.G. Non-random sequences in visual threshold experiments. *Quart. J. exp. Psychol.*, 1956, VIII, 163-171.

Studies the reasons for the occurrence of response runs such as "seen" or "not seen" to the repeated presentation of stimuli of constant intensity. In regard to runs, the authors suggest that the direct influence of a response on the three immediately following responses is more important than possible spontaneous fluctuations of the threshold.

HOWARTH, EDGAR. The role of depth of focus in depth perception. *Brit. J. Psychol.*, 1951, XLII, 11-20.

Studies the relation between illumination level and depth perception. The illumination level ranged from 3 to 36 foot-candles. White rectangles were viewed through a rectangular reduction tube. Within the ranges used, there were smaller constant errors in depth perception at the lower illumination levels. There were positive correlations between depth perception and visual acuity in the central ranges.

HOWEL, W.C., and KRAFT, C.L. The judgment of size, contrast, and sharpness of letter forms. *J. exp. Psychol.*, 1961, 61, 30-39.

Studies the effect of size, contrast, and blur on judged size, contrast and sharpness of letter forms. Reducing two of the dimensions did not adversely affect judgments of size and contrast but did affect sharpness judgments. Reduced sharpness increased the apparent size of the stimulus figure and reduced contrast decreased it.

HUMAN RESOURCES RESEARCH OFFICE. *Bibliography of publications.*

Includes a number of publications which are specifically relevant to detection, identification and localization, as well as publications related to general training problems.

HUNTER, IAN M.L., and DUTHIE, JOHN H. The effect of interpolated experience on visual recognition. *Quart. J. exp. Psychol.*, 1957, IX, 21-27.

Studies the effect of the interpolation of visual presentation of similar figures on the recognition of a single circle-with-gap figure. Twelve year old children were used. The interpolation of circles with different sizes of gap resulted in retroactive interference. Whether the recognition error was positive or negative depended on the nature of the interpolated figures.

HYMAN, R., and HAKE, H.W. *Form recognition as a function of the number of forms which can be presented for recognition.* USAF, WADC, TR 54-164, 1954, AD 50568.

Studies the effect of the number of alternative forms from which the to-be-presented stimulus is drawn on the duration recognition threshold for the form. Different geometric forms as well as different orientations of the same form were used. The duration threshold was significantly higher when the stimulus was one of four possibilities than when it was one of two possibilities. The authors suggest that results from studies on the relative visibility of forms *per se* are not particularly generalizable since recognition does not depend solely on the form itself.

IMBER, B.M., STERN, I.D., and VANDERPLOS, J.W. *Visual field restriction and apparent size of distant objects.* WADC Technical Rep. 54-23, 1954.

Studies the effect of aperture size on the apparent size of a white square variable from 10 to 30 inches viewed monocularly at a distance of 500 feet over open ground. The aperture size varied from 5 to 60 degrees. There was a small but consistent two percent increase in apparent target size regardless of the aperture size used.

ITTELSON, WILLIAM H. Size as a cue to distance: static localization. *Amer. J. Psychol.,* 1951, LXIV, 54-67.

Discusses size as a cue to distance and suggests that there are three classes of cue-distance relationships: (1) relative size as a cue to relative distance; (2) absolute size as a cue to absolute distance; and (3) change of size as a cue to change in distance. The second part of the paper investigates some of the conditions underlying these relationships. The following test objects were viewed monocularly: playing cards of various sizes, match-box, typewritten business letters, and cut out geometrical shapes. Some of the conclusions reached by the author were: (1) a single object viewed monocularly is perceived at a definite radial distance; (2) this apparent distance is determined primarily by the size cue (the object is localized by the observer at a point at which an object of physical size equal to the assumed size would have to be placed in order to produce the given retinal size); (3) discrete changes in the size of the physiological stimulus related to a physical object will be perceived as discrete changes in the apparent distance of that object, provided the assumed size remains constant; (4) these discrete changes can be compensated for or completely over-ridden by changes in assumed size; (5) discrete changes in the characteristics of the physiological stimulus pattern resulting in changes in assumed size will be perceived as discrete changes in apparent distance even though retinal size remains constant.

ITTELSON, WILLIAM H. Size as a cue to distance: radial motion. *Amer. J. Psychol.*, 1951, LXIV, 188-202.

Studies size-change as a cue to the perception of movement towards or away from the observer (radial motion). The stimulus objects were lighted diamond squares, normal and over- and under-sized playing cards, a match box, and a business letter. The author suggests that size serves as an appropriate cue to distance or radial motion only when the observer supplements the stimulus data with assumptions regarding the objective properties of the configuration.

JACKSON, C.W. Visual factors in auditory localization. *Quart. J. exp. Psychol.*, 1953, V, 52-65.

Studies the effect of visual cues on the accuracy of auditory localization. Paired stimuli used were bells and lights and a puff of steam from a kettle whistle with and without whistling sounds. The auditory and visual stimuli were presented at varying degrees of angular separation. The general results were: (1) the addition of visual stimuli increased accuracy of auditory localization; (2) the "visuo-auditory threshold" was 20 to 30 degrees; (3) even with deviations as large as 90 degrees, nearly one-third of the subjects failed to detect the separation.

JEEVES, MALCOM A., and BRUNER, JEROME S. Directional information and apparent movement. *Quart. J. exp. Psychol.*, 1956, VIII, 107-113.

Studies the effect of the number of possible alternative directions on the apparent movement threshold for successively presented points of light. The threshold for movement was lower when the movement could occur in eight rather than two directions.

JENKIN , NOEL. Affective processes in perception. *Psychol. Bull.*, 1957, 54, 100-127.

Reviews the findings regarding the role of affective processes in four areas of perception research: (1) size judgment, (2) physiological need, (3) "selective sensitization", and (4) noxious or threatening stimuli.

JENKIN, NOEL. Effects of varied distance on short-range size judgments. *J. exp. Psychol.*, 1957, 54, 327-331.

Studies the apparent size of objects at short viewing distances. White squares were used at viewing distances ranging from two to 20 feet. Apparent size increased significantly in a two to 10 foot viewing distance. The findings supplement other studies in which similar changes were found under long-range viewing conditions.

JENKIN, NOEL, and HYMAN, RAY. Attitude and distance-estimation as variables in size-matching. *Amer. J. Psychol.*, 1959, LXXII, 68-76.

Studies the effect of instructions to make size matches in terms of the visual angle on size-distance matching. These (analytic) instructions resulted in size matches which were intermediate between those made with adequate depth cues present and those made with those cues absent. The importance of the judgmental instructions is obvious.

JOHNSON, RONALD E. Qualitative changes in the memory-traces of incomplete circles. *Amer. J. Psychol.*, 1962, LXXV, 629-633.

Studies the Gestalt hypothesis of closure as it relates to memory for broken circles. With the exception of circles with a 70 degree gap, the results indicated that closure did not occur. Neither closure nor sharpening occurred with smaller gaps.

JONES, AUSTIN. The efficiency of utilization of visual information and the effects of stress. *J. exp. Psychol.*, 1959, 58, 428-432.

Studies the effect of increasing stress in the form of minimum-perceptible to painful electric shock on recognition thresholds. Probability grid patterns resembling both matrix and Street figures were used. The results showed that the recognition thresholds rose with increasing stress.

JONES, E.E., and BRUNER, J.S. Expectancy in apparent visual movement. *Brit. J. Psychol.*, 1954, XLV, 157-165.

Studies the roles of stimulus context, expectancy, and meaning on the perception of visual movement. Line drawings, stick and nonsense figures were used. The following results were obtained: (1) when two objects cover an identical distance objectively, the object which has more frequently been seen in motion will be seen initially as moving faster and farther; (2) the more probable and practiced an apparent movement, the more adequately will the movement experience maintain itself under sub-optimal conditions; (3) speed and extent of apparent movement are related to the qualitative form of movement promoted by the stimulus context; and (4) when the direction of movement is basically optional or ambiguous, there is a tendency for contextual cues to promote one option or another according to the expectancy aroused.

JOYNSON, R.B., and NEWSON, L. JOHN. The perception of shape as a function of inclination. *Brit. J. Psychol.*, 1962, 53, 1-15.

Studies the kinds of shape judgments which are made spontantaneously when object inclination is varied. Triangles were used as the stimuli. The results indicated that there were both judgments which approximated the true shape and judgments which showed a compromise between true and retinal shape. Further, when making their judgments, some subjects were aware of both possibilities while others were aware of the first possibility only.

JULESZ, BELA. Texture and visual perception. *Scientific American*, 1965, 212, 38-48.

Discusses the role of surface texture and spatial separation in visual discrimination and points out that objects can be discriminated by differences in their surface texture alone even if they are spatially connected and cannot be recognized, and that two unfamiliar objects of identical texture can be discriminated solely on the basis of their spatial separation. Abstract texture patterns were used.

KAHNEMAN, D., and NORMAN, J. The time-intensity relation in visual perception as a function of observer's task. *J. exp. Psychol.*, 1964, 68, 215-220.

Determines the critical durations (exposure times) for the identification of digits and for a subjective brightness match. The results indicate that the critical durations vary as a function of the perceptual task and do not represent the duration of an early "sensory" phase of the visual process. In the present study, the critical duration was 200 to 350 milliseconds for identification and 100 milliseconds for matching.

KAPLAN, IRA T., and RIPPS, HARRIS. Effect on visual threshold of light outside the test area. *J. exp. Psychol.*, 1960, 60, 284-289.

Studies the effect of the luminance, number, and location of spots of light (inducers) surrounding a circular test field on the luminance threshold for the field. The test threshold rose as the luminance and number of inducers was increased. When the inducers were grouped, the rise in threshold was greater than when they were evenly spaced. Varying the luminance, number, or location of inducers produced larger effects in the periphery than in the fovea.

KARN, HARRY W., and GREGG, LEE W. Acquisition of perceptual responses as a function of loading, location, and repetition. *J. exp. Psychol.* 1961, 62, 62-69.

Determines the ways in which the visual perception of elements of a stimulus complex is influenced by the amount of experience with the complex and by specific features of the complex designated as location and loading. The target stimulus was three circles located at the points of an imaginary equilateral triangle. Loading refers to complete presence, complete absence, or random occurrence of a dot within each circle. There was a significant reduction in errors as a function of the number of preliminary 1 sec. presentations under all conditions of loading and location. Both location and loading influenced the magnitude of the error.

KARN, HARRY W., and GREGG, LEE W. *The effects of instructional sets on the perception of peripheral visual stimuli.* Technical Note AFO SR-1919, Psychological Labs., Carnegie Inst. of Technology, 1962.

Studies the effect of the degree of specificity in instructions on the accuracy of recognition. The circle targets of the previous study were used. The instructions were: (1) non-specific, in which the subject was told that sometimes one or more of the circles would contain a dot; (2) problem-solving in which the subject was told that there was some pattern followed; and (3) specific solution, in which the subject was told the pattern (i.e., that only one of the circles changed from trial to trial). Subjects were given 30, 10, or 0 pre-trials at one second exposure. The results showed that the more specific the instructions and the greater the amount of pre-test training, the less was the amount of error.

KARN, HARRY W., GREGG, LEE W., and PITZ, G.F. The effect of systematic and nonsystematic presentation of stimuli on peripheral visual acuity. *J. Psychol.,* 1962, 53, 491-497.

Studies the effect of exposure time and knowledge of when the target will appear on the peripheral acuity for Landolt rings. With exposure times of 0.1 and 0.2 seconds, there was increased acuity with exposure time and when the subject knew when the target would appear. These differences did not obtain with exposure times of 0.5 and 1.0 seconds.

KARWOSKI, T.F., REDNER, H., and WOOD, W.O. Autokinetic movements of large stimuli. *J. gen. Psychol.,* 1948, 39, 29-37.

Studies the autokinetic movement of large form stimuli. Light points mounted on vari-shaped opal glass plate crosses and rings of sizes up to 15 inches were used. The results indicated that autokinesis is not limited to small point sources on a completely dark ground. The shapes were found to move with the light points.

KASWAN, JAQUES, and YOUNG, STEPHEN. Stimulus exposure time, brightness, and spatial factors as determinants of visual perception. *J. exp. Psychol.,* 1963, 65, 113-123.

Determines the effect of exposure time, brightness and spatial arrangement on detection and accuracy of perception. The targets were linear displays of paired or evenly spaced dots imposed for times ranging from 0.004 to 0.512 seconds at intensities ranging from 0.09 to 11.84 millilamberts. Accuracy was largely a function of exposure time and, for paired designs, the amount of relative spatial distance between within-pairs of dots. Detection was a joint function of exposure time and intensity independent of relative spatial distance.

KASWAN, J. W. Tachistoscopic exposure time and spatial proximity in the organization of visual perception. *Brit. J. Psychol.*, 1958, 49, 131-138.

Tests the hypothesis that the perception of groupings in time follows a process of differentiation. Single line and dot patterns varying in the proximity of grouped units were used. In general, the results showed the following exposure-time dependent sequence: indistinct blur, horizontal line of objects, incorrect or unclear groupings, and correct groupings.

KATZ, MILTON S., METLAY, WILLIAM, and CIRINCIONE, PAUL A. *The effects of stimulus and field size on the accuracy of orientation in the homogeneous environment.* Technical Rep. NAVTRADEVCEN IH-13, Communications Psychology Division, Human Factors Laboratory, U.S. Naval Training Device Center, Port Washington, New York, 1964.

Studies the effect of target size on the subject's ability to reposition these in the center of a 270° homogeneous field. The targets were four circular spots of light and ranged in size from 8 minutes to 4 degrees 27 minutes. The results showed: (1) each subject positioned the targets into a perferred field; (2) the largest error and greatest variability was in centering the smallest target; (3) absolute errors were not systematically related to the initial starting points; and (4) errors tended to be smaller in the field containing that subject's perceived center.

KATZELL, R.A., THOMSON, K.F., ZALKIND, S.S., and LANG, E. *Combat recognition requirements*. HER Report SDC 383-6-1, 1952.

Determines the means which men in combat use to detect, locate, and identify targets and recommends ways to improve recognition training. The following recommendations were made: (1) place greater emphasis on personnel and ground weapons; (2) include training in recognizing sounds of weapons; (3) include the tactics and employment of weapons by own and other forces; (4) provide training aids which show targets in motion; and (5) spread recognition training throughout Army training cycles. Early training should be general and stress only major targets. Specific targets and their employment should be taught later and integrated with other training.

KAUFMAN, E.L., LORD, M.W., REESE, T.W., and VOLKMANN, J. The discrimination of visual number. *Amer. J. Psychol.*, 1949, 62, 498-525.

Studies the ability to perceive numerousness in randomly arranged dot fields. In general, the results showed that the observers were accurate, confident, and consistent in estimating up to six dots. Beyond six dots confidence dropped sharply, but accuracy and consistency were good up to twenty-five dots.

KAY, HARRY, and SKEMP, RICHARD. Different thresholds for recognition--further experiments on interpolated recall and recognition. *Quart. J. exp. Psychol.*, 1956, VIII, 153-162.

Studies the effect on difference recognition thresholds of the familiarity of interpolated material. Complex picture materials were used. The results showed: (1) subjects recognized fewer items after interpolated recall; (2) in recognition, a stronger memory has an inhibitory effect on a weaker one; and (3) the juxtaposition of better and less known items raises the recognition threshold of the less known.

KELVIN, R.P., and MULIK, AKTU. Discrimination of length by sight and touch. *Quart. J. exp. Psychol.*, 1958, X, 187-192.

Studies the comparison of stimuli cross-modally and within the same modality and reports the necessity to revise the conclusion from an earlier study. Stimuli were 2 sets of 13 steel rods 5mm. thick. The earlier findings showed that there was no less accuracy when comparing a visual with a tactual stimulus than there was when comparing a visual with a visual or a tactual with a tactual stimulus. The author suggests that the earlier findings were an experimental artifact in that cross-modal comparisons are a function of the total range of the comparison stimuli and not simply a function of the physical properties of the isolated stimuli.

KEMPLER, BERNHARD, and WIENER, MORTON. Theoretical notes. Personality and perception in the recognition threshold paradigm. *Psychol. Rev.*, 1963, 70, 349-356.

Suggests that the relationship between personality and recognition thresholds cannot be adequately explained by perceptual defense or response hierarchies. The authors suggest that recognition is a function of the subject's giving a characteristic response to partial information or supraliminal part-cues.

KENT, ERNEST W. *The ability of human subjects to attend to visual stimuli not centrally fixated.* US Army Infantry Research Unit, Fort Benning, Georgia, 1962.

Investigates the question of whether subjects can attend non-fixated stimuli and whether retention depends on fixation or attention. The results showed that attention could be directed to an object other than the one fixated and that retention is a measure of attention.

KINNEY, JO ANN S. *Night vision sensitivity during prolonged restriction from sunlight.* US Naval Med. Res. Lab. Rep. No. 401, 1963.

Studies the effect of prolonged restriction from sunlight on night vision sensitivity. Subjects were on a three month submerged submarine cruise. There was no evidence that night vision sensitivity could be improved beyond its normal seasonal peak.

KINSBOURNE, M., and WARRINGTON, ELIZABETH K. Further studies on the masking of brief visual stimuli by a random pattern. *Quart. J. exp. Psychol.*, 1962, XIV, 235-245.

Investigates forward and backward masking of a brief stimulus by a random pattern. Capital letters with the exception of I, J, O, and Q were used as stimuli. The masking effect occurs only under certain well defined conditions in which the important parameters are random pattern duration, interval between stimuli, and test stimulus duration.

KLEIN, GEORGE S., GARDNER, RILEY W., and SCHLESINGER, HERBERT J. Tolerance for unrealistic experiences: A study of the generality of a cognitive control. *Brit. J. Psychol.*, 1962, 53, 41-55.

Confirms and extends the findings of an earlier study in which it was demonstrated that subjects consistently differed in their willingness to experience perceptual organizations contradicting what they knew to be true.

KNOLL, HENRY A. *A brief introduction to dynamic visual acuity.* Vision Research Reports, Nat. Acad. Sci., Nat. Res. Council Publ. 835, 1960.

Cites some of the characteristics of dynamic visual acuity as measured by a checkerboard pattern: (1) at angular velocities of 120° and 180° per second there was no correlation with static visual acuity, whereas at 20° and 60° per second, there was a significant correlation; (2) fixed head scores were as good as free head scores; (3) eyes are capable of tracking smoothly at 20° and 60° per second but at 120° and 180° per second there are frequent saccades.

KOLERS, PAUL A. The illusion of movement. *Scientific American*, 1964, 211, 98-106.

Discusses some of the conditions which differentiate real and illusory movement. These are: (1) apparent movement occurs only at certain rates of stimulation; (2) the image of an object moves across the retina when the movement is real, but not in the illusion; (3) real movement produces a blur when the movement is rapid, whereas the blurry appearance of phi movement occurs when the time interval between the turning off of one light and the turning on of the next is made longer than that required for optimal movement; (4) although an observer cannot distinguish between the appearance of real and illusory movement, apparent movement tends to be slower than real movement.

KOOPMAN, BERNARD. Search. In *Notes on operations research.* Operations Research Center, MIT, 1959.

Discusses visual search and conditions which contribute to the probability of detection. The model used is the detection of one ship by another but much of the material applies to other situations.

KRAUSKOPF, JOHN, DURYEA, RICHARD A., AND BITTERMAN, M.E. Threshold for visual form: Further experiments. *Amer. J. Psychol.*, 1954, 67, 427-440.

Extends earlier work on foveal form thresholds as measured by the intensity of illumination necessary for identification. The stimulus figures were: circle, square, diamond, X, L, H, pentagon, and star. The results showed that form threshold varies inversely with exposure-time, with magnitude of critical detail, and to some extent with area. Brightness threshold, like form threshold, varies inversely with exposure-time and with area, but it is unaffected by extensive differences in configuration.

KRENDEL, EZRA S., and WODINSKY, JEROME. *Visual search in unstructured fields. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Cites a series of experiments on visual detection in which the targets were discs of light. The percentage of detections (1) increased with an increase in search time; (2) decreased with an increase of search area; (3) increased with an increase in contrast; (4) increased with an increase in background luminance provided that contrast was changed accordingly; and (5) increased as target size increased.

KRISTOFFERSON, ALFRED B. *Visual detection as influenced by target form.* Form discrimination--as related to military problems. Nat. Acad. Sci., Nat. Res. Council Publ. 561, 1957.

Discusses target detection in terms of an "element contribution" theory of spatial summation which predicts that thresholds decrease as target size increases and that for equal area, all non-circular targets should have higher thresholds than circular ones. The predictions were borne out by the data. Circles had the lowest thresholds, then geometric forms, then long, thin "rectangles" and finally multiple-legged forms.

KRISTOFFERSON, ALFRED B., and BLACKWELL, H. RICHARD. Effects of target size and shape on visual detection: 1. Continuous foveal targets at moderate background luminance. *J. O. S. A.*, 1957, 47, 114.

Determines contrast detection thresholds for circles, squares, rectangles, crosses, spokes, and a number of relatively large regular geometric forms. Circular targets had the lowest threshold contrasts. For rectangular targets, as the length-to-width ratio increased from one to 64, threshold contrast increased. Crosses and spokes had markedly higher threshold contrasts than circles of the same area. The geometrical forms, all equal in area to a 32 minute diameter circle, differed very little in threshold contrast, with circles having the lowest value.

KRUS, DONALD M., WAPNER, SEYMORE, and WERNER, HEINZ. Studies in vicariousness: Effect of muscular involvement on visual thresholds. *Amer. J. Psychol.*, 1958, LXXI, 395-398.

Tests the hypothesis that the recognition of pictorial material representing movement is adversely affected by increases in muscular tonicity. The stimulus material was a line drawing representing a partially bent-over human. The hypothesis was confirmed in that the introduction of muscular involvement was accompanied by decreased perceptual sensitivity.

KRUS, DONALD M., WERNER, HEINZ, and WAPNER, SEYMORE. Studies in vicariousness: Motor activity and perceived movement. *Amer. J. Psychol.*, 1953, 66, 603-608.

Tests the hypothesis that there will be an inverse relation between the frequency of perceiving implied movement and the degree of motor involvement. Stimuli were line drawings of objects which suggested movement. Exposure of the stimuli was preceded by 20 seconds of pushing against a push board. The introduction of motor involvement had the effect of significantly decreasing perceptual movement as measured by verbal responses to the pictorial material.

KULP, CHARLES M., and ROWLAND, GEORGE E. *Daylight visual target detection.* (A search and review of the literature.) Rowland and Company, PO Box #61, Haddonfield, New Jersey. Prepared for Air Crew Equipment Laboratory, Naval Air Material Center, Philadelphia, Pa., Contract No. N156-37937, R&C Report #59-1-1, 1959.

An annotated bibliography which cites some of the literature dealing with visibility and detection at photopic levels of illuminance.

KUNNAPAS, THEODORE M. Influence of frame size on apparent length of a line. *J. exp. Psychol.*, 1955, 50, 168-170.

Studies the effect of frame size on the apparent length of a line enclosed within a 7x7cm. square. The frame greatly influenced the apparent length. Phenomenal length of the line was a logarithmic function of the area and the side of the square-shaped frame. The larger the square, the longer the line must be to appear equal to that of the constant line of 50mm. in the middle of the constant square.

KURTZ, KENNETH H. Discrimination of complex stimuli: The relationship of training and test stimuli in transfer of discrimination. *J. exp. Psychol.*, 1955, 50, 283-292.

Tests the hypothesis that the same training procedures may result in either positive or negative transfer to the discrimination of novel stimuli, depending upon the relationships between the stimuli employed in the training and test tasks. The stimuli were simple patterns such as moon faces, joined rectangles, etc. The results supported the predictions that transfer of discrimination training would be positive when the stimuli employed were distinguished by the same property in both tasks, and that transfer would be negative when the stimuli were distinguished by different properties in the two tasks.

LANDAUER, A.A. The effect of instructions on the judgment of brightness. *Quart. J. exp. Psychol.*, 1964, XVI, 23-29.

Studies the effect of "reflectance", "luminance", or "apparent brightness" instructions on brightness judgments. Stimuli used were a rectangular hardboard box, fitted with electrically driven color mixers and shaft-mounted cardboard discs. Brightness matches were affected by (1) the instructions given to the subject; (2) the relation of a target's reflectance to the reflectance of its surround; and (3) the difference in the levels of illumination of the two surfaces which were compared. Under non-reduced viewing conditions judgments varied significantly depending upon the judgmental instructions given the subject.

LANDAUER, A.A. The effect of viewing conditions and instructions on shape judgments. *Brit. J. Psychol.*, 1964, 55, 49-57.

Studies the effect of "apparent" and non-directing vs. "objective" (real shape) or "projective" (visual angle) instructions on judgments of shape when the targets were presented at various degrees of slant. The stimulus object was an ellipse. Judgments given under apparent and non-directing instructions tended to follow the visual angle expectation under reduced viewing conditions and under conditions of extreme slants. Under improved viewing conditions and with moderate slants they followed the real shape expectation.

LANGDON, J. The perception of three-dimensional solids. *Quart. J. exp. Psychol.*, 1955, VII, 133-146.

Studies shape constancy in three-dimensional objects undergoing progressive physical changes of shape. Stimuli used were frameworks constructed of small diameter tubing and made to fluoresce with ultraviolet radiation and transparencies displayed in a box internally illuminated. The results suggested the general conclusion that the substitution of two-dimensional surfaces for three-dimensional objects is not justified in perceptual research as three dimensional objects have perceptual properties not found in flat surfaces.

LANGER, JONAS; WAPNER, SEYMORE, and WERNER, HEINZ. The effect of danger upon the experience of time. *Amer. J. Psychol.*, 1961, LXXIV, 94-97.

Studies the effect of danger on the perception of time and distance moved. Under conditions of danger subjects overestimated both the distance they had moved and the amount of time that had elapsed.

LAWRENCE, DOUGLAS H., and COLES, GEORGE R. Accuracy of recognition with alternatives before and after the stimulus. *J. exp. Psychol.*, 1954, 47, 208-214.

Studies the effect on accuracy of recognition where the subject is told before or after the pictorial presentation that the stimulus will be one of several alternatives. There was superior performance with alternatives regardless of whether the alternatives were given before or after the stimulus. Performance was superior when discrete alternatives suggesting perceptually different objects were used rather than similar alternatives suggesting perceptually similar objects.

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LAWRENCE, DOUGLAS H., and LABERG, DAVID L. Relationship between recognition accuracy and order of reporting stimulus dimensions. *J. exp. Psychol.*, 1956, 51, 12-18.

Studies the effect of instructions regarding attention and report on the recognition of stimuli varying in color, form, and number of objects. The instructions were: (1) "equal": pay attention to and record all three dimensions; (2) "emphasis": pay primary attention to one dimension but record all three; (3) "one-only": pay primary attention to and record only one dimension; (4) "ordered": pay attention to and record all three dimensions with the order of recording specified. The results showed: (1) the average accuracy on all three dimensions combined differed little with the types of instruction; (2) with Emphasis instructions, accuracy for the attended dimensions was greater than for the other two dimensions; (3) this accuracy was not increased with One-only instructions; and (4) with Ordered instructions the difference in accuracy between the first recorded dimension and the average of the other two was as large as the difference found with Emphasis instructions.

LEIBOWITZ, H., CHINETTI, P., and SIDOWSKI, J. Exposure duration as a variable in perceptual constancy. *Science*, 1956, 123, 668-669.

Cites an experiment on the effect of exposure time on size constancy. A fixation-point of light was presented at the standard before the standard was illuminated, and cues such as perspective and interposition were not eliminated during its illumination. The results showed that estimates made with illumination intervals of .0005 seconds were essentially the same as those made under continuous illumination.

LEIBOWITZ, H.W., and LOMONT, J.F. *The effect of luminance and exposure time upon perception of motion.* One of a series of reports upon perception of motion. WADC Technical Rep. 54-78, Wright Air Development Center, Air Research and Development Command, USAF, Wright-Patterson AFB, Ohio, 1954.

Studies the isochronal threshold velocity (minimum rate of target displacement necessary for the detection of movement) for foveal vision as a function of luminance and exposure time. The isochronal threshold decreased with increasing luminance, first rapidly and then slowing down to a limiting value. In regard to exposure time, increased exposure time shifted the entire function to lower threshold values and minimized the effect of luminance.

LEIBOWITZ, H.W., MYERS, NANCY A., and GRANT, D.A. Frequency of seeing and radial localization of single and multiple visual stimuli. *J. exp. Psychol.*, 1955, 50, 369-373.

Studies the effect of luminance and exposure time on radial localization accuracy. The stimuli were small circles produced by neon glow tubes. Accuracy was independent of the variables of luminance and duration, provided the stimulus or stimuli were visible and an increase in the number of stimuli presented increased the radial localization error per stimulus.

LEIBOWITZ, H., WASKOW, I., LOEFFLER, N., and GLASER, F. Shorter articles and notes--intelligence level as a variable in the perception of shape. *Quart. J. exp. Psychol.*, 1959, XI, 108-112.

Studies the relation between intelligence level and perceived size constancy. Four groups of subjects ranging from institutionalized mental defectives to college undergraduates who had been awarded scholarships, were used. Stimuli were Dodge transparent mirror tachistoscope, white disc and a graded series of ellipses. With increasing intelligence the matches tended to approach the prediction based on the law of the retinal image, thus there was an inverse correlation between intelligence and constancy. It is suggested that the more intelligent subjects adopted an analytic attitude in the experimental situation, while the less intelligent tended to maintain their everyday non-analytic modes of perceiving.

LENDE, HELGA. *Books about the blind; A bibliographical guide to literature relating to the blind.* (New revised edition.) American Foundation for the Blind, New York, 1953.

Some of the material in the bibliography should be useful to night operations researchers.

LEYZOREK, MICHAEL. Two-point discrimination in visual space as a function of the temporal interval between the stimuli. *J. exp. Psychol.*, 1951, 41, 364-375.

Studies the ability to judge the position of the second of a pair of light flashes with respect to the first when the temporal interval between the stimuli is varied. The temporal intervals ranged from 0.25 to 16.0 seconds. There was accurate discrimination with all intervals used. Discrimination was better when there was a clearly framed background than when there were no reference points, as in the dark.

LLOYD, KENNETH E., and JOHNSTON, WILLIAM A. Short-term retention as a function of contextual constraint. *J. exp. Psychol.*, 1963, 65, 460-467.

Studies the effect of interrupting the continuity of contextual passages on the accuracy of recall in a sequential memory task. Prior research had shown that the number of errors depended on the number of items the subject is supposed to be remembering at each recall point, and the number of items he is requested to recall at each recall point. The present study showed that the number of errors decreased as constraint increased and as interruptions decreased. Letter-word pairs were used.

LLOYD, VAN VOORHEES. A comparison of critical fusion frequencies for different areas in the fovea and periphery. *Amer. J. Psychol.*, 1952, LXV, 346-357.

Studies foveal and peripheral sensitivity to flicker. At low intensities the periphery is more sensitive to flicker than the fovea, while for intermediate and moderately high brightness levels, the situation with comparable areas (1° and 2°) is reversed.

LONG, EUGENE R., REID, L. STARLING, and HENNEMAN, RICHARD H. An experimental analysis of set: variables influencing the identification of ambiguous visual stimulus-objects. *Amer. J. Psychol.*, 1960, LXXIII, 553-562.

Studies the role of set in the identification of ambiguous stimuli. Blurred single-letter patterns were used. Set played three roles in augmenting identification: (1) set increased perceptual accuracy by augmenting the discrimination of potentially relevant elements or dimensions; (2) set increased the frequency of identification by reducing the number of possible responses; (3) set also aided identification by making the residual elements in the stimuli more interpretable.

LORDAHL, DANIEL S. Concept identification using simultaneous auditory and visual signals. *J. exp. Psychol.*, 1961, 62, 283-290.

Studies the effect of irrelevant visual and auditory information on the classification of stimuli. Geometric forms and tones and white noise were used. The results showed: (1) as the amount of irrelevant visual information was increased, performance decreased in a linear manner; (2) the variation in the amount of irrelevant auditory information did not significantly affect the number of errors; (3) the number of correctly identified positive instances of the concept significantly decreased as a linear function of the amount of irrelevant visual information and the amount of irrelevant auditory information; and (4) the types of errors made by the subjects gave strong evidence that they responded primarily on the basis of the visual stimuli and tended to ignore the auditory stimuli.

LOUIS, NICHOLAS B. *The effects of observer location and viewing method on target detection with the 18-inch tank-mounted searchlight.* Technical Rep. 91, Human Resources Research Office, 1964.

Determines the effect on target (jeep, tank, and APC) detection of observer position relative to a searchlight and method of viewing (tank range finder, periscope, binoculars, or unaided vision). For all time intervals, binoculars (and, for the first 30 seconds, unaided vision) were significantly more effective in detecting targets than were the range finder and the periscope. Binoculars were the most effective method of identifying targets, with the best performance occurring at observer locations 80 and 160 yards from the searchlight. The probability of detection and identification fell off sharply as target distance increased, and the probability of identifying larger targets (tank and APC) was greater than for the jeep. Data were compiled on the probabilities of detection and identification at various ranges.

LOW, F.N. Peripheral visual acuity. *AMA Archives of Opthalmology*, 1951, 45, 80-99.

The author suggests that the differences between peripheral and central visual acuity are quantitative rather than qualitative and lists a number of factors which influence acuity. These are: differences in meridional acuity, test object differences, brightness, magnitude of individual differences, practice, spontaneous fluctuation, refractive conditions, color, viewing time, movement, physiological factors, individual differences, and other factors.

LOW, F.N. *Effect of training on acuity of peripheral vision.* Civil Aeronautics Administration, Division of Research, Rep. No. 68, 1964.

Discusses the effect of training on peripheral visual acuity. The author concludes that acuity can be improved by training and states that the fundamental requirements are: (1) forcing peripheral interpretation by perimetric apparatus and (2) the exposure of stationary stimuli long enough to give the subject an opportunity to work out his impression of the stimulus.

LUDVIGH, ELEK. Visual acuity during ocular pursuit. In *Vision research reports*, Nat. Acad. Sci., Nat. Res. Council Publ. 835, 1960, 70-75.

Discusses dynamic visual acuity as tested with Landolt rings and states the following conclusions: (1) as angular velocity increases, acuity decreases; (2) with a range of 2 to 1 in static acuity, at an angular velocity of 110° per second, the range is about 30 to 1; (3) at angular velocities of 110° per second, there is a considerable learning effect, whereas at slower velocities, there is not; (4) there are high correlations between horizontal, oblique, vertical and rotary motion; and (5) the dynamic acuity function appears to be the same whether the subject or the object is moving.

LURIA, SAUL M. *Effect of body position on meridional variations in scotopic acuity.* US Naval Medical Research Laboratory, US Naval Submarine Base, Groton, Conn., Rep. No. 424, 1964.

The study confirms previous findings that visual acuity is better for targets displayed on horizontal and vertical axes than for those displayed on diagonal axes and further demonstrates that thresholds are better for targets displayed parallel to the median plane of the observer's head. Thus appropriate head or head and body tilt can improve acuity. Checkerboard targets were used.

MACKWORTH, JANE F. The visual image and the memory trace. *Canad. J. Psychol.*, 1962, 16, 55-59.

Studies the effect of memory and visual image perseveration on the identification of digits. With stimulus durations up to one second, reading time is increased by a visual image which lasts for about one second during which time 3 to 4 digits can be read. With stimulus durations longer than 4 seconds, the limiting factor is the memory capacity.

MARKS, MELVIN R. Some phenomena attendant on long fixation. *Amer. J. Psychol.*, 1949, 62, 392-398.

Describes some perceptual phenomena which occur with prolonged fixation (four minutes) of a circular target. The phenomena were classified as follows: (1) movements of the fixation-point, or changes in its shape ; (2) a periodic variation in light-intensity, or differential spatial intensities at any given moment; (3) a partial or complete blotting out of the phenomenal field; and (4) a tendency for the circle to assume various elliptical or polyangular shapes.

MARX, M.H., MURPHY, W.W., and BROWNSTEIN, A.J. Recognition of complex visual stimuli as a function of training with abstracted patterns. *J. exp. Psychol.*, 1961, 62, 456-460.

Tests the hypothesis that the recognition of a stimulus pattern is superior when subjects have been trained with simplified abstracted versions of the stimulus rather than with the stimulus itself. Subjects were trained on the fully drawn matrix patterns, geometric forms (dots, circles, squares) representing the pattern, or straight lines representing the main lines or major "flow" of the pattern. The results showed that there was significantly better recognition with the geometric representation training.

McFARLAND, R.A., and FISHER, M.B. *Alterations in dark adaptation as a function of age.* Dept. of Industrial Hygiene, Harvard School of Public Health, Boston, Mass., 1955.

Studies the relation between age and some characteristics of dark adaptation. The Hecht-Schlaer Adaptometer was used with male subjects ranging in age from 20 to 60 years. The results showed that: (1) there is a correlation of .89 between age and final threshold level; (2) for every 13 years of age, the intensity of illumination must be doubled to be just seen by the dark adapted eye; and (3) rate of adaptation must be curvilinearly related to age since it is slower for both younger and older subjects than for the intermediate ones.

McKENNELL, A.C. Visual size and familiar size: Individual differences. *Brit. J. Psychol.*, 1960, 51, 27-35.

Studies the relation between object familiarity and accuracy of size judgments. The results suggested that prior knowledge of familiar objects occurring environmentally mainly in one standard size entirely determined the estimate of their size, while even for less familiar and for heterogeneously sized objects there is evidence, in some cases, that non-visual factors were partly active.

McPHERSON A., and RENFREW, S. Asymmetry of perception of size between the right and left hands in normal subjects. *Quart. J. exp. Psychol.*, 1955. V, 66-74.

Studies the judged size of objects held in the hands. The results showed that discs of equal size held simultaneously in each hand tended to be judged unequal, and that, in the majority of subjects, the object held in the dominant hand was perceived to be the smaller.

MIDDLETON, W.E.K. *Vision through the atmosphere.* National Research Laboratories, Canada, 1952.

Deals with the various factors affecting visibility. Formulae, based primarily on contrast, luminance, and size, are presented for calculating visibility ranges. The formulae are developed for a daylight situation and do not take into consideration non-homogeneous objects, backgrounds and terrain.

MIDDLETON, W.E.K., and MAYO, E.G. The appearance of colors in twilight. *J.O.S.A.*, 1952, 42, 116-121.

Studies the perception of color at low light levels. The results showed that purple has the lowest threshold and yellow and green the highest. Full color vision begins at a light level approximating full moonlight.

MILLER, CARYL-ANN, and ENGEN, TRYGG. Supplementary report: Context effects on absolute judgments of length. *J. exp. Psychol.*, 1960, 59, 276-277.

Studies the effect of context and "determining tendency" on the judged length of lines. The results showed that when a line of a constant length was the longest one in a series it was overestimated; when the same line was the shortest, it was underestimated if the shorter lines were seen before the longer ones. If the longer lines were seen first, the reverse held true, i.e., with shorter lines the standard was underestimated and with longer lines it was overestimated.

MILLER, JAMES W., and HALL, ROBERT J. The problem of motion perception and orientation in the Ganzfeld. In M.A. Whitcomb (Ed.), *Visual problems of the Armed Forces.* Nat. Acad. Sci., Nat. Res. Council, 1962, 14-20.

Discusses the motion threshold and the accuracy of positioning an object in an homogeneous Ganzfeld. Subjects were able to center a test object in a light or dark homogeneous field with an average displacement of 2.5 degrees. The threshold for the perception of motion was considerably higher in the dark field.

MILLER, JAMES W., and LUDVIGH, ELEK. *Time required for detection of stationary and moving objects as a function of size in homogeneous and partially structured visual fields. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960.

Discusses the effect of target size and field structure on the detection time for stationary and moving objects. Data are cited which showed that detection time decreased as target size increased regardless of whether the target was stationary or moving in an homogeneous fog-filled field or moving in a slightly structured field.

MOONEY, CRAIG M. Recognition of ambiguous and unambiguous visual configurations with short and longer exposures. *Brit. J. Psychol.*, 1960, 51, 119-125.

Attempts to determine whether visual inspection or a single brief glance of novel stimuli has a greater facilitating effect on later recognition. Exposure times were 0.07 and 5.0 seconds and the stimuli were forms with incidental details, formless masses of details, and forms devoid of details. The results showed that both viewing methods were highly effective with visual inspection having a small but significant advantage.

MOONEY, CRAIG M. *Studies of recognition by means of closure.* Form discrimination as related to military problems, Nat. Acad. Sci., Nat. Res. Council Publ. 56, 1957.

Points out that closure is not correlated with age, practice, intelligence or a large number of psychological variables and cites an experiment to determine the role of viewing time and eye-movements in closure. The results showed: (1) with ample time, performance was the same for unlimited movement and the fixated eye; (2) with the fixated eye, performance was equal for ample time or a fraction of a second; and (3) with brief observations, the introduction of a fixation point made no difference. However, direct inspection lessened the number of false items reported.

MORRIS, AILENE. *Predicting the detection range of a target in a moving field of view.* A review of relevant research published prior to 1957. Visibility Laboratory, Univ. of Calif., Scripps Institute of Oceanography, San Diego 52, Calif.,

Reviews the major references which report experimental data on visual thresholds for static and moving targets. Particular attention is given to data which relate to the prediction of the detection range of targets under observing conditions such that the entire field of view moves across the retina as is the case in certain air-to-ground reconnaissance situations. Under certain conditions targets moving across the visual field can be equated to stationary targets flashed for a single brief exposure.

MORRIS, AILENE. *Pattern target analysis. Part I: A theory; Part II: A psychophysical experiment.* Visibility Laboratory, Univ. of Calif., Scripps Institute of Oceanography, San Diego, 52, Calif., 1959.

Presents a theory of pattern target analysis and cites data which support the theory. The theory proposes that: (1) patterned visual targets have elements or zones that are visually separable in terms of their area and contrast; (2) the visibility of specific targets depends upon their inherent physical characteristics plus the luminance levels under which they are observed; (3) the discernable elements in a patterned target may be considered as several independent targets simultaneously viewed, each with its own detection range; (4) the maximal cue for primary detection is that target element which can be seen at greatest range because of its particular size and contrast with the background; and (5) recognition of a patterned visual stimulus is the discrimination of sufficient details of the target to provide a basis for classifying it.

MORRIS, AILENE. Form discrimination in psychophysics. In Joseph W. Wulfeck and John H. Taylor (Eds.) *Form discrimination as related to military problems.* Armed Forces, NRC Committee on Vision, Nat. Acad. Sci., Nat. Res. Council Publ. 561, 1957, 12-15.

Discusses form recognition or identification and reports that for recognition, size, luminance, etc. must exceed the minimum thresholds necessary for detection.

MORRIS, A., and DIMMICK, F.L. *Visual acuity at scotopic levels of illumination.* MRL Rep. No. 162, 1950, 9, 157-183.

Studies visual acuity at scotopic levels of illuminance. The study indicated a straight line relationship between visual acuity and brightness from 4 to 6 log micro-micro Lamberts. At scotopic levels, brightness is the principal factor in acuity; however, six log micro-micro Lamberts was found to be the upper brightness limit for purely scotopic functions.

MUELLER, C.G. Some factors in human visual discrimination. In *Minutes and proceedings of the Armed Forces NRC Vision Committee, 29th meeting, 16-17 November 1951,* 173-198.

Discusses target characteristics, observing conditions and sensory capabilities as these relate to military problems in detection and discrimination.

MURPHY, GARDNER, and HOCHBERG, JULIAN. Perceptual development: Some tentative hypotheses. *Psychol. Rev.,* 1951, 58, 332-349.

Discusses perception and percept and perception development. Eighteen hypotheses are formulated.

MYERS, THOMAS, SMITH, SEWARD, and MURPHY, DONALD B. *Vigilance as a function of sensory deprivation and social isolation.* Research Memorandum, US Army Training Center Human Research Unit, Presidio of Monterey, Calif., 1963.

Reports one of the studies of HumRRO Work Unit ENDORSE which investigated the effects of several days of sensory deprivation and social isolation on a variety of behaviors. The results of this particular study showed that subjects undergoing three days of sustained isolation in dark quiet cubicles outperformed, on an auditory vigilance and reaction time task, their control group counterparts living under conditions of normally diversified sensory and social experiences.

NACHMAN, M. *The influence of size and shape on the visual threshold of the detectability of targets.* Boston Univ., Optical Research Laboratory, Technical Note 109, 1953.

Tests the hypothesis that the amount of edge, measured in terms of perimeter and "useful edge" (the area within 1.5 minutes of the edge of the target) rather than area, determined the discrimination threshold. The targets were small rectangles of light. In general, the results showed that targets which varied in area but were equal in the amount of useful edge had equal thresholds.

NAZZARO, J.R. The bisection of a visual extent. *Amer. J. Psychol.*, 1964, LXXVII, 403-413.

Studies the effect of field luminance, fiducial line separation and visual field size on the accuracy of bisecting a bounded visual space. The results showed that variability and absolute average error were decreased by increasing field luminance, increased by increasing fiducial line separation, and unaffected by changing the visual field area.

NEEL, SPURGEON, COL. M.C. The aviator's other eye, night vision in Army aviation. *US Army Aviation Digest*, 1961, 7, 20-22.

Discusses night blindness and night vision. The author points out that night blindness is rare and that functional night blindness can be overcome. Some of the factors related to night vision are diet, age, smoking, pre-exposure to bright light, and experience.

NEISSER, ULRIC. Visual search. *Scientific American.* 1964, 210, 94-102.

Discusses and cites research on visual search to locate a given target in an array. Targets were letters imbedded in lines of letters, but the author suggests that the principles found may apply to such natural situations as finding a given face in a crowd. The findings indicated: (1) duration of search is directly related to the number of lines scanned; (2) scan speed is greatly reduced by practice; (3) a recognition system which differs from subject to subject develops with practice; (4) recognition of some of the characteristics of the visual configuration, such as particular angles, open spaces, parallel lines, locations of the geometric center of gravity, etc., rather than identification of the letter, is necessary; (5) the greater the physical dissimilarity between the letter and the context, the quicker it is located; (6) less time is required to find a line *with* a given letter than a line *without* that letter; (7) multiple scan--locating one of two or more possible letters--takes no more time after practice than single scan; (8) an inexperienced subject can scan for an animal faster than for a "K", but such scanning does not benefit as much from practice; and (9) subjects seem to "process" each word lightly.

NICHOLS, T.F., and POWERS, T.R. *Moonlight and night visibility.* Research Memorandum, US Army Training Center Human Research Unit, Presidio of Monterey, Calif., 1964.

Presents a discussion and summary of published data and information relevant to visibility under low levels of natural illumination. The nature and intensity of light changes between sunset and sunrise are described and related to the visibility of objects of military significance. Six field studies of night target detection are reviewed and assessed. Suggestions for future research are offered and procedures for determining the potential availability of moonlight are described.

OLSON, HOWARD D., GOSS, ALBERT E., and VOIERS, WILLIAM D. *Recognition of vehicles by observers looking into a searchlight beam.* Technical Report 49, Human Resources Research Office, 1958.

Studies the relation between recognition and target-searchlight position. The targets were military vehicles. The results showed: (1) detection and identification ranges were essentially identical; (2) in general, as distance from the searchlight became greater, there was a slight decrease in the recognition range; and (3) recognition ranges tended to be greatest when the vehicle was approaching in the brightest part of the beam, or was silhouetted against the brightest part of the beam.

OVER, RAY. Size--and distance--estimates of a single stimulus under different viewing conditions. *Amer. J. Psychol.*, 1963, LXXVI, 452-457.

Studies the effect of stimulus size and distance variations on judgments and estimates of size and distance. The target was a diamond shaped square of light on a milk glass screen. Diagonal sizes of the stimulus were two, three and four inches and distances were 10, 20, and 30 feet. Under unrestricted viewing conditions, size and distance estimates corresponded to the physical size and distance of the stimulus. This was also true of estimated ratios (estimated size/estimated distance). Under reduced viewing conditions, such correspondence was not found, but an error in estimation of size is not necessarily accompanied by an error in estimation of distance in the same direction.

OVER, RAY. Brightness judgments and stimulus size and distance. *Brit. J. Psychol.*, 1962, 53, 431-438.

Studies the effect of instructions and target size and distance on brightness judgments. The target was a diamond shaped patch of light. Under reduced viewing conditions, the stimulus subtending the smaller visual angle was consistently judged less bright than the one subtending the larger visual angle. With "projective" instructions, that is, instructions to think of the stimuli in terms of retinal size, judgments were more a function of stimulus size and distance than they were with "objective" or "apparent" instructions.

OVER, RAY. The effect of instructions on size judgments under reduction-conditions. *Amer. J. Psychol.*, 1960, LXXIII, 599-602.

Studies the effect on size and distance judgments of instructions to judge the stimulus in terms of its real size ("objective") or its projected size ("retinal"). Targets were photographs of stakes. Accuracy of size judgments was not dependent upon the kind of instructions given.

OYAMA, TADASU. Figure-ground dominance as a function of sector angle, brightness, hue, and orientation. *J. exp. Psychol.*, 1960, 60, 299-305.

Studies the effect of sector angle, brightness, hue and orientation on the figure-ground relation of a reversible figure made up of a circle divided into six or eight sectors with alternate sectors of constant hue and brightness. The sectors seen as figures had the following characteristics: smaller angles, brighter surfaces, red (as opposed to blue) hue and vertical and horizontal (rather than diagonal) orientation.

PARDUCCI, ALLEN. An adaptation-level analysis of ordinal effects in judgment. *J. exp. Psychol.*, 1959, 58, 239-246.

Studies the effect of the order of stimulus presentation on judgments of length. Wooden sticks varying in length from 32 to 298 mm. were used. The results showed that judgment scales shifted toward the values of stimuli presented and judged first. Decreasing the number of stimuli or increasing the number of categories reduced the effect.

PAYNE, M. CARR Jr. Color as an independent variable in perceptual research. *Psychol. Bull.*, 1964, 61, 199-208.

Reviews the literature on the effect of hue, luminance and saturation on visual acuity and judgments of distance, size, weight and temperature. The literature suggests that luminance appears to be the major cue to apparent size, distance or weight. Hue is the more important cue to apparent temperature. A chromatic figure seen against an achromatic background produces best acuity.

PAYNE, M. CARR Jr. Apparent weight as a function of color. *Amer. J. Psychol.*, 1958, LXXI, 725-730.

Studies the effect of color on apparent weight. The results showed: (1) different colored objects of the same size differ in apparent weight; (2) the differences are consistent regardless of whether the objects compared are small or large; (3) the differences are related to physical brightness; and (4) no relation between apparent weight and preferences for the colors was found.

PHEMISTER, MARGARET R. An experimental contribution to the problem of apparent reality. *Quart. J. exp. Psychol.*, 1951, III, 1-18.

Studies the conditions which are related to a two-dimensional figure's apparent relief, reality and independence of its ground. A straight line and perspective parallelepiped designs drawn on paper were used. The following conditions were conducive to the figure's taking its own orientation in space: (1) orientation of the paper so the line was seen as perpendicular to the background; (2) monocular viewing; and (3) strong contrasts between figures and ground in size, brightness, microstructure and perspective clues which depended on viewing distance.

PIERCE, JAN. Determinants of threshold for form. *Psychol. Bull.*, 1963, 60, 391-407.

Reviews the "directive state" literature having to do with the effect of need, set, etc. on perception. The author concludes that variables such as need, set and frequency do not affect perception as such, and that many threshold parameters act upon the response system instead of upon the perceptual system.

PIRENNE, M.H., MARRIOTT, F.H.C., and O'DOHERTY, E.F. *Individual differences in night-vision efficiency.* H. M. Stationary Office, London, Med. Res. Council Spec. Report Ser. No. 294, 1957.

Studies the relationship between visual acuity and light thresholds and formulates a "filter factor" theory which hypothesizes that scotopic vision is the same for all subjects except that one may require K times as much light as another in order to perform any visual task. The results showed that acuity was better with higher luminance and that there were significant correlations between acuity and absolute thresholds. In a test of the filter factor theory perceptual efficiency was measured by a score given for the description of a complicated picture under low illumination. The score obtained was improved with training and was closely related to the absolute threshold. If illumination was increased to compensate for differences in the absolute thresholds, then all subjects had similar scores, as predicted by the "filter factor" theory.

PITZ, GORDON F., GREGG, LEE W., and KARN, HARRY W. Response tendencies in the visual detection of single targets. *Percept. mot. Skills*, 1961, 13, 275-280.

Studies the conditions which give rise to detection errors of commission (reporting a dot present when it isn't) and errors of omission (failing to report a dot which is present). When the dot was dim, errors of omission predominated. As visibility improved, errors of commission became more frequent than errors of omission.

POLLOCK, W.T. The visibility of a target as a function of its speed of movement. *J. exp. Psychol.*, 1953, 45, 449-454.

Measures monocular luminance thresholds for a one degree circular spot of white light moving at angular speeds of fifty to two thousand degrees per second. The stimulus traveled twenty degrees either vertically or horizontally. The threshold luminance increased systematically with target speed, yielding a straight line function with a slope near unity when both luminance and speed were plotted logarithmically. Vertical target movement yielded consistently lower luminance thresholds than did horizontal movement.

POSTMAN, LEO. The generalization gradient in recognition memory. *J. exp. Psychol.*, 1951, 42, 231-235.

Tests the hypothesis that the greater the similarity between correct and incorrect items, the higher is the probability that a recognition response will be given to the incorrect item. Letters were used in an original learning-later recognition design. The larger the number of elements common to original learning items and test items, the more frequently were the test items chosen on the recognition test. Thus frequency of recognition responses describes a gradient of stimulus generalization.

POSTMAN, LEO, and BRUNER, JEROME S. Multiplicity of set as a determinant of perceptual behavior. *J. exp. Psychol.*, 1949, 39, 369-377.

Studies the effect of multiple set on perceptual learning and recognition. The results showed that multiplicity of set or intention impairs the efficiency of perceptual selectivity. The subject is slower in recognizing the stimulus, and also fails to benefit from practice. There is a slowdown of perceptual function which may result in the inhibition of meaning, resulting in perceptual "blanks".

POSTMAN, LEO, and BRUNER, JEROME S. Perception under stress. *Psychol. Rev.*, 1948, 55, 314-323.

Studies the effect of stress (failure) on perceptual behavior. In the original and test series three-word sentences and pictures were used. The experimental group was frustrated by being given the impossible task of describing a picture which was presented tachistoscopically at subthreshold speeds. The experimental subjects failed to benefit from practice, and their thresholds for recognition of the sentences did not change. Premature and often nonsensical interpretations of the stimuli were made.

POSTMAN, LEO, BRUNER, JEROME S., and WALK, RICHARD D. The perception of error. *Brit. J. Psychol.*, 1951, XLII, 1-10.

Studies the effect of an incongruity (a reversed letter) on the speed and efficiency of perceptual organization. The major results were: (1) reversed letters, over all conditions of the experiments, are named correctly at longer exposure times than printwise letters; (2) the presence of a reversed letter slows down recognition of other parts of the field; and (3) the presence of a reversed letter frequently causes phenomenal changes in the total stimulus field, e.g., reversal of the total series of letters.

PURDY, JEAN, and GIBSON, ELEANOR J. Distance judgment by the method of fractionation. *J. exp. Psychol.*, 1955, 50, 374-380.

Studies the ability to divide an extent into halves and thirds. The field was a 300 yard stretch of flat grass-covered ground. The stimulus marker was a bicycle moving toward or away from the observer. There was good accuracy in dividing the distance into halves and thirds. Error was related to the direction of motion of the target; the constant error tended to be positive as the bicycle approached, and either less positive or negative when the bicycle withdrew.

RAYMOND, CHARLES K., and MIGHELL, CHARLES R. *Target placement on a detection proficiency course.* Staff Memorandum, Human Research Unit No. 3, OCAFF, PO Box 2086, Fort Benning, Ga., GWU, 1954.

Studies the ability to discriminate distance differences between target locations. The targets were kneeling and standing enlisted men in Army fatigues. The observers were in the prone and standing positions. The results showed that within approximate ranges of 50 to 300 yards, one target must be about 25% farther away from the other for the presence of the separation to be perceived without error.

RAPPAPORT, MAURICE. The role of redundancy in the discrimination of visual forms. *J. exp. Psychol.*, 1957, 53, 3-9.

Studies the effect of redundancy on the ability to recognize visual patterns under two conditions of visual noise. Metric figures were used. When background noise was present redundancy facilitated rapid discrimination; when stimulus noise was absent an increase in redundancy increased recognition times.

REILLY, R.E., and TEICHNER, W.H. Effects of shape and degree of structure of the visual field on target detection and location. *J. O. S. A.*, 1962, 52, 214-218.

Studies the effect of visual field shape and structure on target detection and location. The fields were undivided circles and squares or circles and squares divided into two, three, four, or five equal parts by vertical lines or concentric rings. Both detection and localization were generally better with the square field. For both fields, detection and localization varied directly with search time. The optimum amount of structuring for both fields was reached when the field was divided into only two equal parts.

RHODES, FEN. *Predicting the difficulty of locating targets from judgments of image characteristics.* Technical Documentary Rep. No. AMRL-TDR-64-19, Behavioral Sciences Lab., Aerospace Med. Division AF Systems Command, Wright-Patterson AFB, Ohio, 1964.

Determines through factor analysis the factors related to judged target difficulty and to the search time required to locate targets in aerial photographs. The factors identified were: (1) target size; (2) picture sharpness and contrast; (3) picture detail; (4) logical restrictions on possible target location; (5) target shape and pattern; (6) target location; (7) target isolation; and (8) rater bias.

RIGGS, L.A., RATLIFF, F., CORNSWEET, J.C., and CORNSWEET, T.N. The disappearance of steadily fixated visual test objects. *J. O. S. A.*, 1953, 43, 495-501.

Studies the disappearance of fixated targets. With prolonged viewing, fixated lines disappear. The rate of disappearance decreases as angular width of the lines increases. Eye movements prevent the disappearance.

RIOPELLE, ARTHUR J., and CHOW, KAO LIANG. Scotopic area-intensity relations at various retinal locations. *J. exp. Psychol.*, 1953, 46, 314-318.

Studies the area-intensity relationship at various retinal locations. The results showed: (1) there was a significant difference in over-all threshold at the various retinal locations; (2) the longer the duration of the test flash, the lower the intensity required for threshold; (3) the larger the stimulus patch, the lower the threshold; and (4) the area-intensity relation was invariant with respect to locus of its determination.

ROBINSON, EDWARD J. The influence of photometric brightness on judgments of size. *Amer. J. Psychol.*, 1954, 67, 464-474.

Studies the effect of photometric brightness on size judgments. The stimuli were illuminated discs 25 feet from the observer. Under both monocular and binocular regard, the brighter target appeared larger. As the absolute brightness level was increased, the effect of the brighter object in any particular brightness ratio was decreased.

ROBSENBAUM, GERALD, DOBIE, SHIRLEY I., and COHEN, BERTRAM D. Visual recognitive thresholds following sensory deprivation. *Amer. J. Psychol.*, 1959, LXXII, 429-433.

Studies the effect of sensory deprivation on visual recognition thresholds. The test stimuli were five digit numbers. With both partial and complete deprivation of visual pattern stimulation, recognition thresholds were lowered following five minutes of deprivation but returned to normal with longer periods up to 30 minutes.

ROCK, IRVIN, and ENGELSTEIN, P.A. A study of memory for visual form. *Amer. J. Psychol.*, 1959, LXXII, 221-229.

Studies the memory for visual form as measured by recognition and reproduction. Random angular and curved edge shapes were used. There was no decrement in accuracy over a period of three or four weeks when the method of recognition was used, and a pronounced decrement when the method of reproduction was used.

ROCK, IRVIN, and HEIMER, WALTER. The effect of retinal and phenomenal orientation on the perception of form. *Amer. J. Psychol.*, LXX, 1957, 493-511.

Studies the effect of retinal and phenomenal position on the recognition of ambiguous figures which can be perceived in either of two ways. Unclosed Street-type figures, and previously viewed nonsense figures were used. Under all conditions the figure which was physically upright, rather than the figure which was upright to the 90 degree tilted retina, was favored in recognition.

ROCK, M.L. Visual performance as a function of low photopic brightness levels. *J. appl. Psychol.*, 1953, 37, 412-427.

Determines the critical brightness levels for three visual tasks. The results showed that .05 foot Lamberts was the point at which further increases in brightness had little effect in reducing errors for Muller-Lyer judgments of equality, absolute motion thresholds, and judgments of depth.

ROCK, M.L. *Annotated bibliography on visual performance at low photopic illumination levels.* USAF, AMC, AF TR No. 5822, 1949, ATI 55506.

Surveys the literature dealing with visual performance as related to the tasks required of military personnel. The major topics covered are visual acuity, physiological concommittants of vision, visual fields, distance and depth perception, and form and motion discrimination.

ROCK, IRVIN, and BROSGOLE, LEONARD. Grouping based on phenomenal proximity. *J. exp. Psychol.*, 1964, 67, 531-538.

Repeats a study by Corbin to determine whether the Gestalt law of grouping by proximity is based on proximity on the retina or perceived proximity in phenomenal space. The results showed that the crucial factor in grouping is phenomenal rather than physical proximity.

RUBINSTEIN, MORTON K., and LOEB, MICHEL. *Interaction between vision and audition.* Army Medical Research Lab., Project No. 6-95-20-001, Report No. 151, 1955.

Studies the effect of auditory stimulation on vernier visual acuity. White noise and pure tones were used. Auditory stimulation impaired visual acuity. However, visual stimulation had no significant effect on auditory thresholds.

RYAN, T.A., and SCHWARTZ, CAROL B. Speed of perception as a function of mode of representation. *Amer. J. Psychol.*, 1956, 69, 60-69.

Compares the threshold exposure times for recognition of cartoons, line drawings, photographs and shaded drawings. Recognition was quickest for cartoons and slowest for line drawings. The time required for photographs and shaded drawings was about equal and fell between the other two.

SAMPSON, H., and SPONG, P. Handedness, eye-dominance, and immediate memory. *Quart. J. exp. Psychol.*, 1961, XIII, 173-180.

Studies the relation between handedness and eye-dominance on the immediate recall of digits. Right eye-dominant groups, particularly a right handed and right eye-dominant group, were superior in both accuracy of recall and speed of response to left eye-dominant groups. Least able in recall were left handed, left eye-dominant subjects. Superiority of right eye-dominant groups was especially marked when a different type of digit was projected simultaneously to each eye.

SAMPSON, PHILIP B., and WADE, EDWARD A. *Literature survey on human factors in visual displays.* RADC TR 61-95, The Institute for Psychological Research, Tufts Univ., Medford 55, Mass. Prepared for Rome Air Development Center, Air Research and Development Command, USAF, Griffiss Air Force Base, N.Y., 1961.

This literature survey presents annotations under four major headings: (1) information load and speed; (2) display format and content; (3) display integration; and (4) human complex processes as related to displays.

SCHIPPER, LOWELL M. Prediction of critical events in contexts of different numbers of alternative events. *J. exp. Psychol.*, 1956, 52, 377-380.

Studies the prediction of a critical event (a short flash of a particular light) as a function of the relative occurrence of that event and the number of alternative events which were flashes of similar lights. The frequency of positive responses was significantly influenced by the proportion of occurrences of the critical event. However, the number of alternative events appeared to have no effect on the subject's performance.

SCHMIDT, HARALD-EDWIN. Relation of the narrowing of the visual field with an increase in distance to manifest anxiety. *J. exp. Psychol.*, 1964, 68. 334-336.

Studies the effect of anxiety as measured by the Taylor Manifest Anxiety Scale on the narrowing of the visual field with increases in distance. Stimuli were squares, diamonds, and parallelograms. The results showed the normal narrowing of the visual field with increased distance, but the visual angle was greater for the high-anxiety group, i.e.,high-anxiety subjects showed consistently less of the normal narrowing of the visual field than did low anxiety subjects, but the difference was significant only at the shortest distance.

SCOTT, D.M. *An annotated bibliography of research on eye movements published during the period 1932-1961.* Defense Research Medical Laboratories. Defense Research Board, Department of National Defense, Canada. DRML Project No. 246, PCC Project No. D77-94-20-46, DRML Report No. 246-11, H.R. No. 226, 1962.

SEABORNE, A.E.M. Group influence on the perception of ambiguous stimuli. *Brit. J. Psychol.*, 1962, 53, 287-298.

Studies the effect of stimulus ambiguity on the tendency to conform to group pressures. Stimuli were comparison cards. Conformity was not related to the ambiguity of the stimulus. However, certainty of correctness varied inversely and response time varied directly with ambiguity.

SENDERS, VIRGINIA L. The physiological bases of visual acuity. *Psychol..Bull.*, 1948, 45, 465-490.

Discusses various approaches to the definition of visual acuity as well as several theories of visual acuity.

SHARP, L.H., GORDON, D., and REUDER, M. *Review of studies on the effects of training on night vision ability.* PRS Report 974, Personnel Research and Procedures Branch, the Adjutant General's Office, Dept. of the Army, 1952.

Reviews some of the military literature concerned with night vision training and testing programs. The author states that there is no evidence supporting the effectiveness of a night vision training program as evaluated by performance in an actual field situation, and that, as evaluated by simple testing devices, training is relatively ineffective and in no case exceeds the amount of gain due to a retest.

SHAW, WILLIAM A. Facilitating effects of induced tension upon the perception span for digits. *J. exp. Psychol.*, 1956, 51, 113-117.

Studies the effect of induced muscle tension on the perception span for digits. Optimal tension varied as a function of task difficulty. Induced tension facilitated the performance of both the good and the poor performers.

SHIPLEY, WALTER C., NANN, BARBARA M., and PENFIELD, MARY JANE. The apparent length of tilted lines. *J. exp. Psychol.*, 1949, 39, 548-551.

Studies the effect of angular position on the judged length of lines. The lines were displayed in half-hour steps at clock positions from three to six o'clock. The apparent length increased from three o'clock to a maximum at five o'clock and then decreased again.

SHOPLAND, CHARMIAN, and GREGORY, RICHARD L. The effect of touch on a visually ambiguous three-dimensional figure. *Quart. J. exp. Psychol.*, 1964, XVI, 66-70.

Studies the effect of tactual exploration on the visual reversal of a Necker cube. With tactual exploration, visual reversals still occurred but the reversal rate decreased and the time during which the cube was seen veridically increased.

SHORE, MILTON F. Perceptual efficiency as related to induced muscular effort and manifest anxiety. *J. exp. Psychol.*, 1958, 55, 179-183.

Studies the effect of muscular effort and drive level as measured by the Taylor Manifest Anxiety Scale on the recognition of nonaffective stimuli. The stimuli were standard acuity targets. Subjects with high Manifest Anxiety scores showed a significant increase in efficiency, while subjects with low Manifest Anxiety scores showed a decrease in efficiency as induced effort was increased. The subjects with middle-range Manifest Anxiety scores showed a rise in efficiency to an optimal level, then a gradual decline.

SINGER, JEROME L. Personal and environmental determinants of perception in a size constancy experiment. *J. exp. Psychol.*, 1952, 43, 420-427.

Studies the effect of personal and environmental variables on size constancy. The stimuli used were a standard square and squares containing a nonsense figure, a circle or a blank surface. The results showed that meaningful content--a schematic "happy face"--led to an enhancement in perceived size and that extroverts as compared with introverts and frustrated subjects as compared with non-frustrated ones showed greater constancy.

SLACK, CHARLES W. Familiar size as a cue to size in the presence of conflicting cues. *J. exp. Psychol.*, 1956, 52, 194-198.

Studies the effect of familiar or usual size on the size judgments of distorted familiar objects. Small, normal, and large chairs were presented outdoors at 20, 30, and 40 yards on a flat field. The larger chairs were judged to be smaller and the small chairs larger than sticks of the same height located near the observer.

SLEIGHT, ROBERT B. The relative discriminability of several geometric forms. *J. exp. Psychol.*, 1952, 43, 324-328.

Studies the discriminability of geometric forms as measured by speed of sorting time. Twenty-one kinds of figures were used. In terms of differences between mean sorting times, there were four groups of stimuli. The group requiring least time was composed of swastika, circle, crescent, airplane, cross, and star, and the group requiring most time was composed of octagon, double concave, heptagon and hexagon.

SLEIGHT, R.R., and DUVOISIN, G. *An annotated bibliography of form perception.* USN, ONR, 1952, ATI 168888.

Reviews forty studies of form discriminability.

SMITH, A.H. Delay of response in the perception of slant and shape. *Canad. J. Psychol./ Rev. Canad. J. Psychol.*, 1964, 18, 235-244.

Studies the effect of response delay on the judged slant and shape of an homogeneous circle, rectangle, and triangle viewed monocularly under reduced conditions at 0, 20, 40, and 60 degrees geometric slant. The response delays were zero, two, four, and eight seconds. The results showed that delay produced a significant over-all decrement in apparent slant which, for both no delay and delay, was significantly less than geometric slant and significantly greater than 0°. Delay had no significant over-all effect on apparent shape which, for both no delay and delay, was similar to projective shape.

SMITH, SIDNEY L. Color coding and visual search. *J. exp. Psychol.*, 1962, 64, 434-440.

Studies the effect on search time of display density, number of colors used, particular color of target, with either a white or black background under conditions when the subject either did or did not know the target color in advance. The displays consisted of three-digit numbers. The results showed that neither the particular color of the target nor the display background had any significant effect on search time. Search time increased regularly with increasing display density. For multicolored displays, when the color of the target was known in advance, search times were considerably shorter than when the target color was unknown. When the color of the target was unknown, search times were not significantly different from those for single-colored displays.

SMITH, STANLEY W. *Time required for target detection in complex abstract visual display.* Memorandum of Project MICHIGAN, Institute of Science and Technology, The Univ. of Michigan, US Army Signal Corps, Dept. of the Army, 1961.

Studies the effect on search time of the number of objects present in the display and the similarity between the target and non-target objects (pseudotargets). Targets used were squares, circles, triangles, pentagons, and hexagons with different targets used in different parts of the study. The results showed that search time (1) increased as the number of pseudotargets in the display increased; (2) decreased as size and brightness contrasts between target and pseudotargets increased; and (3) increased as the number of target sides increased.

SMITH, STANLEY W., and BLACKWELL, H. RICHARD. Effects of target size and shape on visual detection: II. Continuous foveal targets at zero background luminance. *J.O.S.A.*, 1957, 47, 114.

Studies the effect of target size, shape, and form on recognition thresholds. Circles, rectangles, crosses, and spokes were used. Background luminance was zero. Circular targets had the lowest threshold contrasts for a given target area; as the length-to-width ratio increased, the threshold for rectangular targets increased, and spoke targets had considerably higher thresholds than circles of equal area.

SMITH, STANLEY W., and LOUTTIT, RICHARD T. *Some effects of target microstructure on visual detection. Visual search techniques.* Nat. Acad. Sci., Nat. Res. Council Publ. 712, 1960, 94-98.

Studies the effect of target microstructure on visual detection. Targets were grids, checkerboards, and random patterns against an homogeneous background. Element size varied from 1.33 to 3.44 minutes. Target patterns differed in detectability only when they were exposed for a relatively long time (1.00 seconds) at high background luminance (29 foot candles). The grid pattern was then easiest to detect, the checkerboard pattern was most difficult, and random targets were intermediary. The author concludes that the degree of organization of elements *per se* is not a fundamental variable for detection.

SMITH, W.M. The sensitivity to apparent movement in depth as a function of "property of movement". *J. exp. Psychol.*, 1951, 42, 143-152.

Studies the effect of object familiarity on the onset of movement sensitivity. Sensitivity did not vary significantly for objects which in everyday life are frequently seen in flight or in some kind of movement. A baseball, for example, was not responded to any quicker with respect to onset of movement than were meaningless objects such as a disc.

SMITH, W.M., and GULICK, W.L. Dynamic contour perception. *J. exp. Psychol.*, 1957, 53, 145-152.

Studies the perception of a moving stimulus in relation to onset, speed, and termination of movement. Contour movement was produced by a Michotte-like device. The major results showed that: (1) the sharp contour of a moving stimulus cannot be observed when its velocity exceeds a value of about 10-15° per second; (2) by exposing a stimulus in a fixed position before and after movement, contour can be maintained during movement up to velocities of at least 25-30° per second; and (3) contour is maintained most effectively under the conditions studied when movement is both preceded and followed by equal magnitudes of exposure of the stimulus in fixed positions.

SPRAGG, S.D.S. Visual performance on perceptual tasks at low photopic brightness. *J. Soc. of Motion Picture and Television Engineers*, 1951, 2.

The author states that visual tasks of a perceptual rather than of an acuity nature become difficult and inaccurate at levels around 0.01 and 0.1 foot Lamberts.

STEEDMAN, W.C., and BAKER, C.A. *Target size and visual recognition.* WADD Technical Report 60-93, 1960, AD 235129.

Studies the effect of target size on speed and accuracy of form recognition. The targets were angular nonsense forms. Mean search time and mean errors for picking a previously exposed form from new forms rose sharply as target size was below 12 minutes of visual angle.

STONE, P.T., and CORKINDALE, K.G. *Some factors affecting the efficiency of vision at night.* Report # 88, Clothing and Stores Experimental Establishment, US Army Infantry Human Research Unit, Fort Benning, Ga., 1957, AD 158707.

Discusses night vision as well as some of the environmental and physiological conditions which affect rate and level of dark adaptation.

SWEENEY, E.J., KINNEY, J.A.S., and RYAN, A. Seasonal changes in scotopic sensitivity. *J.O.S.A.*, 1960, 50, 237-270.

Scotopic sensitivity was found to vary seasonally, varying inversely with the amount of exposure to sunlight. The amount of seasonal variation for an individual was as great as the normal differences between individuals, although there were still significant individual differences in any one season.

SWETS, JOHN A. Decision processes in perception. In John A. Swets (Ed.), *Signal detection and recognition by human observers.* New York, John Wiley & Sons, 1964.

Discusses signal detection and asserts that detection involves more than sensory information in that all detection requires a criterion and many non-sensory factors are integrated into this variable.

SYMONS, J.R. The effect of various heteromodal stimuli on visual sensitivity. *Quart. J. exp. Psychol.*, 1963, XV, 243-251.

Studies the effect of a heteromodal stimulus on visual sensitivity. The results showed that, with one exception, all the stimuli produced a small increase in visual sensitivity. Visual sensitivity increased when the subject was stimulated simultaneously by: oil of cloves; nasal (as opposed to oral) breathing; warming the right hand (45° C); a cube of sugar in the mouth; rhythmic squeezes of a rubber ball; and rotation in a revolving chair. Visual sensitivity did not increase when the simultaneous stimulus was a 1000 cps tone 60 db above threshold.

SZAFRAN, J. Changes with age and with exclusion of vision in performance at an aiming task. *Quart. J. exp. Psychol.*, 1951, III, 111-118.

Studies the effect of age and visual restriction on an aiming task. The subjects were 20 to 60 years old. Their task was to point at targets which corresponded spatially to the position of lights in a display. Vision was restricted by the use of red goggles through which only the display could be seen. Subjects over 40 took more time than the younger ones for parts of the task which required new action. With restricted vision, the older subjects found it more difficult to locate targets and tried to supplement tactual and kinesthetic cues by turning their heads and bodies towards the target at which they were aiming.

TAYLOR, JOHN E. *Identification of stationary human targets.* Research Memorandum, US Army Infantry Human Research Unit, Fort Benning, Ga., 1960.

Studies the effect of various kinds of night vision training (classroom, field, and classroom and field combined) on the identification of human targets at night. Both targets and observers were in the prone, kneeling and standing positions. The results showed that under "no moon" conditions, the 50 percent correct response distance was at 27 to 30 yards. The range was about three times as long under "full moon" conditions. Under "no moon" conditions, standing targets could be seen best and there was no effect of observer position. Under "full moon" conditions, the best results were obtained with both standing targets and observers. Under "no moon" conditions there was a slight advantage for the field and classroom-field training groups; there were no differences between the groups under "full moon" conditions.

TAYLOR, JOHN H. Contrast thresholds as a function of retinal position and target size for the light-adapted eye. In M. A. Whitcomb (Ed.), *Visual problems of the Armed Forces.* Nat. Acad. Sci., Nat. Res. Council, 1962, 13.

Studies the effect of target size and retinal location (eccentricity from fixation) on contrast detection thresholds. Targets were relatively high (75 foot Lamberts) adapting luminance. With an increase in target size there was a decrease in the contrast threshold and relatively less effect from the eccentricities of the target. With the smaller targets, as eccentricity increased up to 4°, there was a rapid rise in threshold which tended to level out for any greater eccentricity.

TEFT, L., WAPNER, S., WERNER, H., and McFARLAND, J.H. Relation between perceptual and conceptual operations: Numerical distance and visual extent. *Brit. J. Psychol.*, 1964, 55, 421-427.

Tests the hypothesis that if a visual extent is demarcated by two numbers (from 1 to 9), the perception of extent varies depending on the numerical interval used. The results showed that an extent demarcated by a smaller numerical interval appeared equal to a visual extent demarcated by a greater numerical interval when the former extent was physically smaller relative to the latter.

TEICHNER, W.H., KOBRICK, J.L., and WEHRKAMP, R.F. The effects of terrain and observation distance on relative depth discrimination. *Amer. J. Psychol.*, 1955, 68, 193-208.

Studies the effects of observation distance, type of terrain and time of day on monocular and binocular depth discrimination. Rectangular targets were viewed at distances ranging from 200 to 3000 feet over macadamized, sand, silt, and desert pavements. Tests were conducted in the morning and afternoon. The results showed: (1) errors in judged equality increased from about five feet at a viewing distance of 100 feet to about 100 feet at a viewing distance of 3000 feet; (2) there were small but significant terrain effects which appeared to be due to differences in ground contour; (3) generally, binocular viewing was superior to monocular viewing; and (4) time of day had no effect on accuracy.

TEICHNER, W.H., and SADLER, ERNEST. Effects of exposure time and density on visual symbol identification. *J. exp. Psychol.*, 1962, 63, 376-380.

Tests the hypothesis that at short exposure times, increasing display density increases target identification, but that at longer exposure times the opposite effect obtains. The displays were letters which varied in the number of different letter categories, letter density and exposure times. Density had to do with repeating the letters randomly at different parts of the display while keeping the number of different letter categories constant. The subjects were required to report letter categories without regard to density. The results confirmed the hypothesis.

TEICHNER, W.H., and WAGNER, MAHLON. *Visual after-images as a source of information.* Tech. Report NAVTRADEVCEN 1303-3. Institute of Environmental Psychophysiology, Univ. of Mass., Amherst, Mass. (US Naval Training Device Center, Port Washington, N.Y.) 1964.

Studies the role of retinal after-images as facilitators in the recognition of briefly glimpsed, visual display material. Display materials were slides containing capital Latin letters photographed from black on white transfers; the projected images were black letters on a light ground. The results showed that under certain viewing conditions the retinal after-images of the material added enough viewing time (about 10 to 15 seconds) to substantially improve the subjects' reports of what they had seen.

TEUBER, HANS-LUKA. Perception. In John Field, H.W. Magoun, and Victor E. Hall (Ed .), *Handbook of Physiology, A critical, comprehensive presentation of physiological knowledge and concepts, Section 1: Neurophysiology*, Volume III, Chapter 65. American Physiological Society, Washington, D.C., 1960.

Presents a comprehensive survey covering many aspects of visual perception.

THOMAS, F.H., CARO, P.W., and HESSON, J.M. A field study comparison of visual search methods in aerial observation. Paper read at meeting of APA, 1959.

Determines the effective visual search technique in an air-to-ground recognition test using colored slides of near-ground, near-aerial and far-aerial views. Air observation performance was influenced by aircraft speed and the method of search used. In the case of method the most important factor of visual search was head movement rather than head position of the observer.

THOMAS, FRANCIS H., and CARO, PAUL W. Jr. *Training research on low altitude visual aerial observation. A description of five field experiments.* Research Memorandum No. 8, 1962, US Army Aviation Human Research Unit, Fort Rucker, Alabama.

This memorandum gives a detailed report of five field experiments conducted by the US Army Aviation Human Research Unit, under Work Unit OBSERVE. The purpose of the Work Unit was to develop improved methods for training human air observers. The experiments dealt with: (1) visual search; (2) recognition training; (3) geographical orientation; and (4) target location.

TOWNSEND, C., FRY, G.A., and ENOCH, J.M. *The effect of image degradation on visual search: Aerial haze.* Mapping and Charting Research Laboratory, MCRL T.P. No (696)-13-269, Project No. 1155, Task No. 15001, Ohio State Univ., 1958.

Studies the effect of aerial haze on search time. Stimuli were degraded photographs simulating conditions of aerial haze (reduced-contrast). Under conditions of simulated haze both the search time to locate critical details and the duration of visual fixations increased.

TSAO, J.C. A study in the recognition of figures. *Brit. J. Psychol.*, 1949, XL, 57-67.

Studies the memory changes for figures using the recognition method. The stimuli were letters, line drawings, a clock face, etc. The results showed that as intervals between presentation and recognition lengthened, percentages of correct recognition decreased. As the intervals became longer, the subjects tended to mistake more forms for the original stimulus.

TULVING, ENDEL. The relation of visual acuity to convergence and accommodation. *J. exp. Psychol.*, 1958, 55, 530-534.

Tests the role of convergence and accommodation in visual acuity. The target was a pair of parallel lines. Acuity decreased with increasing angles of convergence when relatively unpracticed observers were used. This effect was shown to be independent of changes in convergent accommodation. For observers who had received longer practice in an experimental situation, acuity was found to be independent of both convergence and convergent accommodation. Other evidence appears to show that visual acuity is independent of observation distance when the distances are larger than one or two meters, but that it decreases with decreasing distances below this limit.

UHLANER, J.E., GORDON, D.A., WOODS, J.A., and ZEIDNER, J. The relationship between scotopic visual acuity and acuity at photopic and mesopic brightness levels. *J. app. Psychol.*, 1953, 37, 223-229.

Studies the relation between photopic, mesopic, and scotopic visual acuity. Acuity was measured with the following tests: the Army Night Vision Tester, Modified Landolt Ring, Army Snellen, Line Resolution, Quadrant Variable Contrast and the Ortho-Rater. Scotopic acuity scores were moderately correlated with photopic acuity scores and more highly correlated with mesopic acuity scores. However, adequate assessment of scotopic and photopic acuity requires two separate tests.

VAN DE GEER, J.P., and LEVELT, W.J.M. Detection of visual patterns disturbed by noise: An exploratory study. *Quart. J. exp. Psychol.*, 1963, XV, 192-204.

Studies the effect of noise on visual detection using 15 patterns made of lines and dots. There was a strong tendency to make type II errors in detecting a pattern disturbed by noise. Stable and even patterns were more "noiseproof" than irregular and undetermined patterns.

VANDERPLAS, JAMES M. Transfer of training and its relation to perceptual learning and recognition. *Psychol. Rev.*, 1958, 65, 375-385.

Discusses concepts arising from the study of transfer of training and discusses their implications for perceptual learning and recognition. In regard to recognition, it depends upon the discriminability of stimuli, and is inversely related to transfer. Selection responses, made to new stimuli, reflect positive transfer, and also failure of discrimination and false recognition.

VANDERPLAS, JAMES M., and GARVIN, EVERETT A. The association value of random shapes. *J. exp. Psychol.*, 1959, 57, 147-154.

Studies the association value of random shapes varying in complexity. The results indicated a range of association value from 20% to 62% for the shapes examined. An inverse relation was noted between the complexity of the shapes and the number, content, and heterogeneity of associative responses, while a positive relation existed between the other variables.

VAUGHAN, W.S., and KASSEBAUM, R.G. *Target definition, location and selection.* Research Report V, PRA Report 57-11, Psychological Research Associates, Washington, D.C., 1957.

Studies the variables which determine the priority of target selection in a military situation simulating combat. The priority with which a target was selected as an aiming point increased with: (1) increased size of the area of potential enemy threat; (2) decreased range of the area of potential enemy threat; and (3) increased intensity of fire from the area of potential enemy threat. The results also showed: (1) at any given range, differences in bush size had no influence on target selection priority; (2) at any given intensity of fire, differences in bush size had a significant effect on target selection priority; and (3) at any given intensity of fire, differences in range had a significant effect on target selection priority.

VERNON, M.D. Cognitive inference in perceptual activity. *Brit. J. Psychol.*, 1957, 48, 35-47.

Discusses the role played by inference in perceptual identification. The author suggests that inferential thinking occurs when the sensory data are scanty or ambiguous or contain incongruities. Some inferences and judgments would be similar for different individuals because of experiences common to all persons; whereas other inferences and judgments would be ideosyncratic because of individual experiences.

VERNON, M.D. Different types of perceptual activity. *Brit. J. Psychol.*, 1947, 38, 79-89.

Studies the kinds of perceptual activity involved in the recognition of pictures, jumbled objects, letters and numbers, shapes, scales, patterns, and diagrams. The results suggested that perceptual efficiency is highly specific. However, there were some indications of two general factors influencing perception: (1) the ability to perceive and discriminate pure shape and pattern characteristics which appeared to be related to the differential brightness threshold, but not to intelligence; and (2) the ability to make a further interpretation of the sensory and perceptual data in accordance with some predetermined set or scheme. In the experiments, three types of set could be distinguished, toward the perception of: (1) representations of real objects; (2) imaginatively interpreted pictures; and (3) symbolic material such as letters, numbers, scales, etc.

VERPLANCK, W.S. Report of the working group on night vision training. *Minutes and proceedings of the Armed Forces NRC Committee on Vision, 29th Meeting, 16-17 November 1951*, 49-55.

Discusses night vision training, points out the features which are essential and outlines a detailed training program.

WALL, FRANCIS U. Techniques of night navigation. *Infantry*, 1964, 54, 19-21.

Discusses two techniques of navigating terrain at night: (1) dead reckoning, or navigating from a known starting point and following a predetermined direction for a specified distance; and (2) navigation by prominent terrain features.

WALLACE, JEAN G. Some studies of perception in relation to age. *Brit. J. Psychol.*, 1956, XLVII, 283-297.

Studies the relation of age to object identification. The ages ranged from 20 to 70 years and the displays consisted of: (1) outlines of geometric figures; (2) silhouettes of simple figures; (3) "meaningful" silhouettes; and (4) more complex pictorial representations. With simple displays there were no age effects; with complex displays the older age groups were slower in making correct identifications. In complex displays correct identifications were related to the cumulative viewing time and the amount of the display seen at one moment.

WALLACH, HANS, and NORRIS, CYNTHIA M. Accommodation as a distance-cue. *Amer. J. Psychol.*, 1963, LXXVI, 659-664.

Studies the role of accommodation as a cue to distance. The results suggested that for viewing distances under one meter, accommodation is an important cue for distance.

WAPNER, S., McFARLAND, J.H., and WERNER, H. Effect of visual spatial context on perception of one's own body. *Brit. J. Psychol.*, 1963, 54, 41-49.

Studies the effect of visual spatial context on apparent arm length and apparent head width. Apparent arm length and apparent head width were relatively larger in an "open-extended" visual spatial context than in a "close-confined" spatial context.

WAPNER, S., and WITKIN, H.A. The role of visual factors in the maintenance of body-balance. *Amer. J. Psychol.*, 1950, LXIII, 385-408.

Studies the ability to maintain balance on an unstable platform under various visual field conditions. Visual fields were: (1) full or highly structured; (2) limited or weakly structured; (3) unstable or moving; and (4) absent when the subject was blindfolded. As the visual field was weakened, eliminated, and finally made unstable, balance deteriorated progressively for men and women.

WARDEN, C.J., BROWN, H.C., and ROSS, SHERMAN. A study of individual differences in motion acuity at scotopic levels of illumination. *J. exp. Psychol.*, 1945, 35, 57-70.

Determines motion acuity thresholds in the peripheral retinal position at illuminance levels of log minus 3.4 and log minus 4.0 millilamberts. The results showed that: (1) the motion acuity function for each level of illumination was found to be regular, with a gradual rise as the peripheral angle increased; (2) the range of individual differences in motion acuity threshold values is extremely marked, and shows a steady increase from the 7 degree retinal position outward; and (3) the threshold value of the worst subject was over 40 times as large as that of the best subject.

WARHURST, FRANK, and MURDOCK, BENNET B. Jr. *The recognition of complex stimuli.* Research Memorandum Norn-3219 (02) (x), Univ. of Vermont Burlington, Vt., 1962, AD 429838.

Studies the recognition of numbers vs. complex forms in a card sorting task. The forms were either colored or cross-hatched and consisted of a triangle, star, diamond, heart, ellipse, circle, square or airplane. Three-digit numbers were used. There were significantly more "false positives" (calling a new card old) with figures than with numbers, but otherwise the two types of stimuli were recognized with about equal accuracy.

WATKINS, WILLIAM H. Effect of certain noises upon detection of visual signals. *J. exp. Psychol.*, 1964, 67, 72-75.

Studies the effect on visual signal detection of auditory noise when continuously present as opposed to being present only with the visual signal. The visual signal was a patch of light and the auditory noise was either white noise or auditory flutter at 75 db sound pressure level. Detection was substantially better when noise was presented only during the observation intervals than when it was continuously present.

WEBSTER, R.G., and HASLERUD, G.M. Influence on extreme peripheral vision of attention to a visual or auditory task. *J. exp. Psychol.*, 1964, 68, 269-272.

Studies the effect on peripheral detection of directing attention to an auditory or foveal task. Both auditory and foveal counting tasks had equally significant detrimental effects on both the number of responses and reaction time to peripheral lights. The counting tasks were almost 100% accurate.

WEINER, JACK, and LEIKIND, MORRIS C. *Visibility, A bibliography*. The Library of Congress Reference Department. Technical Information Division, Washington, D.C., 1963.

Provides a survey of much of the literature published from 1925 to 1950 inclusive on the subject of visibility as influenced by the various physical, psychological, and physiological factors inherent in the observer, target, background and atmosphere. (The survey is not complete for the years 1948-50.)

WEINSTEIN, SIDNEY. The perception of depth in the absence of texture-gradient. *Amer. J. Psychol.*, 1957, LXX, 611-615.

Studies the effect of the absence of a ground texture gradient on the perception of depth. Photographs of an open field with stakes driven into the ground at various distances from the observer were used. When ground texture was removed, depth perception was unimpaired.

WHITE, BENJAMIN W. *Complexity and heterogeneity in the visual recognition of two-dimensional forms*. Form discrimination as related to military problems. Nat. Acad. Sci., Nat. Res. Council Publ. 561, 1957.

Studies the effect of complexity and homogeneity-heterogeneity (less open as opposed to more open space in the figure) on the ease of identification. The homogeneous forms were significantly more difficult to identify than the heterogeneous ones, and the complex forms were significantly more difficult than the simple ones. The difference between the homogeneous and heterogeneous forms held for both simple and complex forms but the difference between simple and complex forms held only under the homogeneous condition.

WHITESIDE, T.G.D., and GRONOW, D.G.C. *Vision in an empty visual field. The effect of empty field myopia upon the minimum visual angle.* RAF Inst. Aviat. Med., FPRC 872, 1954, AD 119474.

Studies the effect of an empty visual field on the detection threshold for a target in that field. The results showed that the minimum visual angle must be twice as large for detection of a target in a detail-less field as opposed to one containing some detail.

WHITTENBURG, JOHN A. A proposed development of air-to-ground detection/identification model. In Peter G. Nordlie, *Studies of Social and Psychological Vulnerabilities of U.S. Society to Nuclear Attack.* Current Research, Human Sciences Research, Inc., 7710 Old Springhouse Road, McLean, Va. 22101, 1959.

Lists a proposed study the object of which is to develop a predictive model for unaided visual detection and identification of tactical targets.

WHITTENBERG, JOHN A., SCHREIBER, ALVIN L., ROBINSON, JOHN P., and NORDLIE, PETER G. *Research on human aerial observation, Part I: Summary*, Research Memorandum, HumRRO Division No. 6 (Aviation), (Subcontractor: Human Sciences Research, Inc.) 1960.

Reports some of the research of HumRRO Work Unit OBSERVE I which had as its purpose the development of a training program for aerial observers for scanning, target detection, and target identification. The difficulty of target detection was shown to be affected by: (1) the apparent square mile size of the target and target exposure time; (2) the degree to which targets were camouflaged or concealed; and (3) variations in illumination, visibility, and weather. The major factor limiting more effective target identification appeared to be a lack of knowledge of the names and appearances of military objects when presented under diverse conditions.

WHITTENBERG, JOHN A., BARLOW, CLIVE, DEVENY, KENNETH L., WARNE, ROBERT D., and SCHREIBER, ALVIN L. *Research on human aerial observation, Part III: Summary data from tactical field tests*. Research Memorandum, US Army Aviation Human Research Unit, Fort Rucker, Ala., 1960.

Reports the data obtained from four tactical field tests of aerial observer capabilities. The report contains a brief description of the four tests, a statement of the major findings on aerial observer proficiency, and a number of tables containing summary data on observer capabilities.

WHITTENBERG, JOHN A., SCHREIBER, ALVIN L., and RICHARDS, B.F. *A field test of visual detection and identification for real and dummy targets*. Research Memorandum, US Army Aviation Human Research Unit, Fort Rucker, Ala., 1959.

Reports the findings of HumRRO Work Unit OBSERVE in a field test of target identification and target discrimination of real vs. dummy targets. The observer flew over the targets which were in simulated battlefield dispositions. In regard to dummy targets, the results showed that they provided highly realistic simulation. Differences in the amount of structural detail, general shape, and internal color contrast aided in the discrimination of larger dummy targets. Discrimination of real and dummy targets was affected by the square mile size of the targets and the experience of the observers. The accuracy of target identification was affected by apparent size, the training and experience of the observer, and, to some extent, by the angle of observation.

WITKIN, H.A., and ASCH, S.E. Studies in space orientation: III, Perception of the upright in the absence of a visual field. *J. exp. Psychol.*, 1948, 38, 603-614.

Studies the effect of body tilt on the perception of the vertical and horizontal in the absence of a visual field. Adjustments of a luminous rod to the true vertical or horizontal were very accurate when the body was upright, but errors appeared as soon as the body, or even the head alone, was tilted. The largest errors occurred when the body was horizontal.

WOLF, E., and ZIGLERM, M.J. *Some relationships of glare and target perception.* AML, WADC, Wright-Patterson AFB, Ohio, 1959.

Determines the visibility of targets in the vicinity of a glare source. The conditions varied in terms of exposure times and retinal locations, size and luminance of the glare source, and angular separation between target and glare source. The targets were Landolt rings, letters and dials. Target thresholds were lowered as glare luminance and glare source area decreased and as target size and distance between target and glare source increased. Thresholds also decreased with increases in target exposure time up to one second.

WORCHEL, PHILIP, and DALLENBACK, KARL M. "Facial vision": Perception of obstacles by the deaf-blind. *Amer. J. Psychol.*, 1947, 60, 502-553.

Studies the detection of the presence of obstacles by the deaf-blind. The results of this and subsequent studies showed that the detection of obstacles depends on audition. Deaf-blind subjects can neither detect nor learn to detect obstacles, whereas blind-only subjects can.

WULFECK, JOSEPH W., WEISZ, ALEXANDER, and RABEN, MARGARET W. *Vision in military aviation.* WADC Technical Report 58-399, The Institute for Applied Experimental Psychology, Tufts Univ. in cooperation with Jackson and Moreland, Inc., Engineers, with contributions by Col. George O. Emerson, Aero Medical Laboratory, Contract No. AF 33(616)-2906, Wright Air Development Center, Air Research and Development Command, USAF, Wright-Patterson AFB, Ohio, 1958, AD 207780.

Covers such topics as the nature and measurement of light, the physiology of vision, visual capacities, and factors influencing vision and visibility.

ZAJAC, J.L. Is binocular correspondence and disparity still a dominant factor in binocular depth perception? *Psychol. Bull.*, 1964, 62, 56-66.

Reviews and discusses the research on binocular depth perception. The author concludes that for the near visual field binocular correspondence and disparity cannot be supplanted by other theories of binocular depth perception.

ZAJAC, J.L. Investigations on depth perception in indirect vision. *Brit. J. Psychol.*, 1953, XLIV, 132-144.

Studies the role of accommodation and color in depth perception. The first part of the study showed the importance of accommodation in the visual depth perception for non-fixated objects. The second part of the study showed that objects with longer wave-lengths of light are seen as nearer while those with shorter wave-lengths are seen as farther away.

ZEIDNER, J., GOLDSTEIN, L.G., and JOHNSON, C.D. *Factor analysis of visual acuity tests during dark adaptation.* PRB Technical Research Note 40, Personnel Research Branch, Dept. of the Army, Washington, D.C., 1954.

Landolt rings, chevron contrast tests and general aptitude tests involving sensory tasks were used in a factor analytic study of visual acuity during the course of dark adaptation. Eight factors were isolated: Factor A, "Rod-Adapted Resolution"; Factor B, "Cone-Adapted Resolution"; Factor C, "Cone-Adapted Brightness Discrimination"; Factor D, "Rod-Adapted Brightness Discrimination"; Factor E, "Cognitive or Experiential Factor"; Factor F, "Form Perception"; Factor G, "Glare Recovery"; Factor H, "Perceptual Speed Factor".

ZIGLER, MICHAEL J., and WOLF, ERNST. Uniocular and binocular scotopic parafoveal sensitivity. *Amer. J. Psychol.*, 1958, LXXI, 186-198.

Studies the relation between the position of the blind spot and the sensitivity in the other eye. A two degree square test-field was used at varying distances from the fovea. The lack of sensitivity caused by the blind spot in one eye was found to be compensated for by high sensitivity in the other eye. The binocular thresholds were slightly lower than those of the more sensitive eye.

ZUCKERMAN, CARL B., and ROCK, IRVIN. A reappraisal of the roles of past experience and innate organizing processes in visual perception. *Psychol. Bull.*, 1957, 54, 269-296.

Reviews and discusses the material bearing on the question of past experience vs. innate tendencies as determiners of perception. The author suggests: (1) visual direction appears unlearned; (2) the evidence is equivocal regarding visual constancies but naive empiricism appears inadequate; (3) the evidence is equivocal for depth perception; (4) some visual reflexes are innate; and (5) the evidence is equivocal for form perception.

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13. ABSTRACT

This literature survey was undertaken to explore information on the nature of and conditions for effective visual perception at low light levels. From the survey, 407 reports or studies were selected for inclusion in the annotated bibliography. With a few exceptions, the material falls within the areas of detection, identification, and localization. Many laboratory studies are included which could undergo appropriate modification for repetition in natural settings at low light levels. In each annotation the purpose and the results or conclusions of the study are stated; method and procedure are indicated only briefly.

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